AQUATIC ASSESSMENT REPORT
PROPOSED SEVEN HILLS SURFACE MINE
WARRICK COUNTY, IN

Prepared for:

Peabody Energy
Lynnville, Indiana

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September 2017

Eco-Tech CONSULTANTS

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1. INTRODUCTION

Eco-Tech Consultants, Inc. (Eco-Tech) was contracted by Peabody Energy of Lynnville, Indiana to assess current aquatic conditions at a proposed surface mine in Warrick County, Indiana. The proposed site is within the Seven Hills Permit Area. Eco-Tech has previously performed an aquatic assessment at this location in 2011, along with several other ecological studies.

2. STUDY AREA

The project area is within the Southern Wabash Lowlands (U.S. Environmental Protection Agency [U.S. EPA] Level IV ecoregion). This area is characterized by an undulating landscape consisting of many wide, shallow valleys. Soils are neutral to acid ic, and originally the area was covered with oak-hickory forests on upland sites and mesophytic forests on lowla nd sites. Row crop agriculture and surface mining are prevalent land uses within the landscape surrounding the project area (Woods et al. 1998).

The site is bound on the north by Seven Hills Road (County Road 750 N) and to the south by Boonville-New Harmony Road (County Road 400 N) on the Daylight, Boonville, and Elberfeld, Indiana USGS Topographic Quadrangles. The permit area lies mostly within the western floodplain of Pigeon Creek. V arious roads and trails occur throughout the project area (Figures 1). The total acreage of the site is 1,680 acres and is predominantly forest with som e cropped areas and former mine impoundments.

Pigeon Creek is a fourth order tributary t o the Ohio River. The stream's watershed drains approximately 225 square miles near the southern terminus of the project area (USGS, 2012). Pigeon Creek has been extensively channelized, and remnants of the original course exist as scrolling wetlands and oxbows visible on aerial imagery (Figure 1). The aquatic study area is within the Highland-Pigeon Creek drainage basin (HUC 05140202).

3. METHODS

Potential sample loca tions were identified using GIS data and knowledge of the site collected during previous studies, and three of the sites (AS1, AS2, and AS3) were previously sampled by Eco-Tech (2011b). Six potential sample locations with intermittent or perennial flow reg imes were assessed to determine if suitable habitat was present to maintain aquatic assemblages that could be adequately sampled. Five of the proposed six sites contained flowing water at the time of sampling and were included in the survey: one site on a n intermittent tributary stream and four sites on the mainstem of Pigeon Creek (one upstream of the proposed mine, one at the upper end of proposed mine , and two below the proposed mine area) (Figure s 1). Proposed aquatic site 4 (AS4) did not have adequate stream flow to sample (Appendix A).

Eco-Tech collected information on stream habitat characteristics, water chemistry, and fish and benthic macroinvertebrate communities on August 28 -29, 2017 . Data collection was completed using the most current Indiana Department of Environmental Management (IDEM) standard operating procedures obtained from IDEM staff Ali Meils and Stacey Sobat (pers. comm., 8/23/2017).

3.1. Stream Habitat Description

Sample points were photographed and assessed according to the U.S. Environmental Protection Agency (USEPA) Rapid Bioassessment Protocol (RBP) for low -gradient streams and IDEM *Procedures for Completing the Qualitative Habitat Evaluation Index* (QHEI) *B-003-OWQ-WAP-XX-16-T-R0 Technical Standard Operative Procedure (2016)* by Ec o-Tech staff . Drainage areas were delineated using the US Geological Survey web interface program StreamStats (v4.1.2; USGS 2012).

3.2. Water Quality Sampling

Water t emperature, dissolved oxygen, and total dissolved solids were measured in the field with a handheld YSI 85 system (YSI Incorporated), and pH was measured with a pHTestr 1 (Oakton). Eco-Tech collected water samples for measurement of additional parameters and delivered them to Rosedale Services, Inc. in Boonville, Indiana. Levels of total iron, t otal manganese, acidity, alkalinity, and total dissolved solids were determined.

3.3. MacroinvertebrateCommunity Assessment

IDEM Aquatic macroinvertebrate sampling followed the protocol as defined in *Multi-habitat* (MHAB) *Macroinvertebrate Collection Procedure S-001-OWQ-W-BS-10-T-R0 Technical Standard Operating Procedure (2014)*.

Sweep samples were used to collect macroinvertebrates at each aquatic sample point . During the sweep sample, best professional judgment and experience were used to sample as many microhabitats (rootwads, emergent vegetation, woody debris, leaf packs, sandy and silty substrates, and cobble and gravel substrates) as possible, sampling these microhabitats in 1.5-2 meter intervals along 50 meters of shoreline habitat. Due to the fact t hat the streams are low gradient, and no substantial riffles were present at the proposed sample points, riffle kick samples were modified for short riffles, runs, and glides according to MHAB procedures.

Samples were elutriated, and placed into a white s orting tray. Samples were picked for 15 minutes, and the resulting subsample of invertebrates was preserved in 70 percent ethanol. Invertebrates were identified by Pennington and Associates, Inc. (Cookeville, TN) to "lowest practical taxon" as per IDEM guidance.

Taxa numbers were tabulated to calculate metrics used to produce the Indiana macroinvertebrate Index of Biotic Integrity (mIBI). The metrics were calculated using tolerance values, feeding groups, and habit behavior classifications provided by IDEM in their "Indiana Macroinvertebrate Taxa Attributes" document. Values were then assigned to a ranking system and summed to produce the mIBI according to instructions provided by IDEM in their "Calculating IDEM Macroinvertebrate Index of Biotic Integ rity (mIBI)" document (provided by Ali Meils, IDEM Senior Environmental Manager).

3.4. Fish Community Assessment

Fish communities were sampled using a backpack electrofisher (Halltech Aquatic Research Inc. HT2000B/MK5) according to protocols designed by IDEM' s Surface Water Quality Assessment Program (provided by Stacey Sobat, IDEM Section Chief for the Probabilistic Monitoring Program). A length of stream equal to 1 5 times the stream width was sampled, ensuring equal and representative coverage of both banks . At least one individu al per species, per site was preserved as a voucher specimen, as well as any unidentified specimens. All individuals were identified and enumerated by an Eco-Tech biologist familiar with low gradient stream fauna of southwest Indiana.

Taxa numbers were tabulated to calculate metrics used to produce an Index of Biotic Integrity (IBI). The metrics were calculated using sensitivity categories, trophic guilds, reproductive guilds, and additional classifications provided by IDEM in t heir document entitled "Appendix with Taxa Characteristics for IBI Calculations." Values were then assigned to a ranking system and summed to produce the IBI according to instructions provided by IDEM in their document entitled "Interior River Lowland Cal ibration Summary" (provided by Stacey Sobat, IDEM Manager Section Chief for the Probabilistic Monitoring Program). Qualitative descriptors for IBI scores were provided by IDEM.

It should be noted that high levels of total dissolved solids were observed w hich can be problematic with electroshocking (Kolz and Reynolds 1989; Burkhardt and Gutreuter, 1995). Typical v oltage levels had to be reduced in order to prevent electrical overl oading of the backpack unit. In order to offset this, additional time and s urveyed area was added to the effort at each location. Fish seining was largely impossible due to the high accumulation of coarse woody debris anchored in the fine sediment.

4. RESULTS

4.1. Stream Habitat Description

Stream channels at all five sample sites ha ve been altered by human activities. Pigeon Creek (sites AS1 , AS3, AS5, and AS6) has been extensively channelized , and s ite AS2 is on a channel that appears to be a man-made conveyance built to drain a final cut impoundment from previous surface mining activities. EPA RBP habitat assessment and IDEM Qualitative Habitat Evaluation Index (QHEI) forms are provided in Appendix B. Stream characteristics are summarized in Table 1.

Sites on Pigeon Creek (AS1, AS3, AS5, and AS6) received lower RBP and QHEI scores than AS2 due to a lack of canopy cover, homogeneous fine substrate , and little development of diverse aquatic habitats. Sites AS5 and AS6 received higher QHEI scores than AS1 and AS3 primarily because of greater bank stability and habitat heterogeneity . Channel substrate at all sites is primarily silt/soil ; however, a few isolated gravel deposits and areas of exposed hardpan comprised of clay and gravel were noted . Within the sections of Pigeon Creek surveyed fine sediment bars were observed forming in the center of the stream channel. Sites AS1 and AS3 received scoring indicating impaired waterways. Photos of sample locations are provided in Appendix A.

Previous stream habitat analysis noted that stream AS1, AS2, and AS3 received EPA RBP scores of 126, 47, and 126, respectively. The scoring from previous years is similar to the curre nt survey (Appendix D). Site AS2 did receive higher RBP scoring likely due to beaver impact having a stabilizing effect on flow regime and the progressive growth of woody vegetation within the riparian habitat in the years between survey years.

Table 1. Stream characteristics at aquatic sample sites within the proposed Seven Hills Mine in Warrick County, Indiana.

Sample Site	Flow Regime	Dominant Channel Material	IDEM QHEI Score	EPA RBP Score
AS1	Perennial	Silt	46	112
AS2	Intermittent	Gravel	45	88
AS3	Perennial	Silt	48	102
AS5	Perennial	Gravel	53	96
AS6	Perennial	Silt	52	107

4.2. Water QualityResults

Physical and chemical parameters measured at the five aquatic sample sites are provided in Table 2. These measurements will provide monitoring data, wh ich can be compared to previous conditions. Water quality standards for aquatic life in Ohio and Illinois River from Indiana's Administrative Code, Minimum Surface Water Quality Standards (327 IAC 2 -1-6), have a dissolved oxygen (DO) lower standard of 4.0 mg/L. All sample sites from this survey were at or below this standard, indicating a strong organic component in the system and lack of habitat and gradient to adequately oxygenate the water column.

Total dissolved solids (TDS) at all five sites are ele vated. While IDEM does not have an aquatic life standard for TDS, elevated water salinity, as measured by specific conductivity and a dominant component of TDS, has been shown to negatively affect aquatic life in freshwaters (U.S. EPA 2016). This parameter may reflect anthropogenic land use influences in the watershed and may also be driven by a strong groundwater hydrologic influence. Although the survey data of TDS and DO indicate water quality may be at levels to cause stress to aquatic organisms, it was not determined if these results are from naturally occurring sources or from

anthropogenic effects. All other parameters were within typical water quality standards for unimpaired waterways.

Table 2. Physical and chemical measurements of water in streams within the proposed Seven Hills Mine in Warrick County, Indiana.

Parameter	AS1	AS2	AS3	AS5	AS6
Temperature (°C)	22.7	25.8	22.9	22.5	23.2
Dissolve Oxygen (DO)	4.00	3.80	3.90	3.87	4.05
pH	8.1	8.2	8	7.9	8.2
Total Dissolved Solids (mg/L)	1440	1100	2110	2230	2070
Total Acidity (mg/L as CaCo3)	<10	<10	<10	<10	<10
Total Alkalinity (mg/L as CaCo3)	313	280	256	344	255
Total Iron (mg/L)	0.16	<0.1	<0.1	<0.1	0.18
Total Manganese (mg/L)	<0.1	<0.1	<0.1	<0.1	<0.1
Total Suspended Solids (mg/L)	<10	<10	11.7	<10	23

Previous physical and chemical parameter by Eco-Tech (2011b) noted that total dissolved solids at sites AS1, AS2, and AS3 were noted to be high at the time of sampling. All other parameters fell within the water quality parameters of the time (Appendix D).

4.3. Macroinvertebrate Sampling Results

Previous macroinvertebrate sampling at AS1, AS2, and AS3 yielded a total of 241 individuals of 32 taxa. The most common taxa sampled at all three sites included clam shrimp (Spinicaudata), narrow-winged damselflies (*Enallagma* spp.), net-spinning caddisflies (*Cheumatopsyche* spp.), and riffle beetles (*Stenelmis* spp.) (Appendix D).

Macroinvertebrate from 2017 sampling effort yielded a total of 1,196 individuals of 77 taxa. Macroinvertebrate IBI scores ranged from 34 to 38, and IDEM considers streams scoring less than 36 to be impaired. All sites exhibited some level of stress to the faunal community making them borderline impaired reaches.

Higher metric scoring for individual sites in general resulted from low percentages of Orthocladiinae and Tanytarsini of Chironomidae, non-insects minus crayfish, and tolerant taxa. The low scores obtained for individuals sites in general are the result of several indicators of poor stream health, including the number of EPT (Ephemeroptera, Plecoptera, Trichoptera) taxa, percent shredders and scrapers, and percent collector filterers. The highest score was observed at AS3, and this is due to the fact that the greatest number of individuals and greatest percentage of intolerant taxa were collected there.

While more individuals and taxa were collected in 2017 than in 2011, the taxa observed did not exhibit a high quality macroinvertebrate community. Significant results common among all five sites included narrow-winged damselflies (*Enallagma* sp.), net-spinning caddisflies (*Hydropsyche* sp.), and various midge species (*Polypedilum illinoense* group and *Tanytarsus sp.*).

Taxa that occurred at four of the five sites included small minnow mayflies (*Callibaetis floridanus*), dancer damselflies (*Argia* sp.), forktail damselflies (*Ischnura* sp.), net-spinning caddisflies (*Cheumatopsyche* sp.), and various midge species (*Dicrotendipes neomodestus*, *Glyptotendipes* sp., *Polypedilum flavum*, *Ablabesmyia mallochi, Conchapelopia* sp., and *Procladius* sp.) The most abundant species found at all five sites was *Polypedilum illinoense* group (n=220), and the most abundant species from the entire survey effort was *Cheumatopsyche* sp. (n=243; Appendix C). Some of the taxa (midges and damselflies) are commonly found in lentic habitats (pools) in vegetation, mud, debris, or rootwads, which are common in Pigeon Creek. The small minnow mayflies and net-spinning caddisflies, are often found in areas with more flowing water. Taxa richness was greatest at AS1, AS3, and AS5 most likely to greater habitat heterogeneity between riffle, pool, woody debris, root wad, and leaf pack habitat.

Table 3. Metrics used to calculate the macroinvertebrate Index of Biotic Integrity and resulting scores for streams sampled within the proposed Seven Hills Mine in Warrick County, Indiana.

Parameter	AS1		AS2		AS3		AS5		AS6	
	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score
Number of Taxa	34	3	20	1	34	3	32	3	30	3
Number of Individuals	216	3	212	3	123	1	495	5	150	3
Number of EPT Taxa	4	1	3	3	2	1	8	3	5	1
% Orthocladiinae + Tanytarsini of Chironomidae	3.2%	5	6.6%	5	4.1%	5	3.4%	5	6.7%	5
% Non-insects Minus Crayfish	7.9%	5	4.7%	5	5.7%	5	1.0%	5	10.0%	5
Number of Diptera Taxa	15	5	8	3	20	5	16	5	14	5
% Intolerant	29.6%	3	42.9%	5	0.0%	1	18.0%	3	14.7%	1
% Tolerant	6.5%	5	3.8%	5	14.6%	3	12.7%	3	8.0%	5
% Predators	18.5%	3	3.3%	1	29.3%	3	17.4%	1	22.0%	3
% Shredders + Scrapers	0.5%	1	0.5%	1	2.4%	1	2.2%	1	2.0%	1
% Collector-Filterers	39.4%	1	87.7%	1	13.8%	3	20.6%	1	28.0%	1
% Sprawlers	2.3%	1	0.5%	1	10.6%	5	3.4%	3	6.0%	5
Total Scores		**36**		**34**		**36**		**38**		**38**

*<36=impaired, ≥36=unimpaired.

4.4. Fish Sampling Results

Previous sampling on Pigeon Creek (Eco-Tech, 2011b) indicated qualitative ratings of fair (AS1 and AS3) and poor (AS2), yielding a total of 295 individuals and 25 taxa. Channel catfish (*Ictalurus punctatus*), green sunfish (*Lepomis cyanellus*), and bluegill (*Lepomis macrochirus*) were found at all three sites. Other relatively populous species (>10 individuals) included black bullheads (*Ameiurus melas*), steelcolor shiners (*Cyprinella whipplei*), blackstripe topminnows (*Fundulus notatus*), and golden shiners (*Notemigonus chrysoleucus*), and two species known to be sensitive to and/or intolerant of pollution were captured: long-eared sunfish (*Lepomis megalotis*) and dusky darter (*Percina sciera*). No species captured in the 2011 survey is listed as

threatened or endangered by the U.S. Fish and Wildlife or the state of Indiana (Eco-Tech 2011b; Appendix D).

In 2017, sampling yielded 17 fish species. IBI scores ranged from 17 to 24. Fish communities at four sample sites were classified as indicative of poor stream habitat and one site's community was classified as very poor (58-60=Excellent, 48-52=Good, 40-44=Fair, 28-34=Poor, 12-22=Very Poor, <12=No Fish). The low scores obtained at all five sites were caused by low overall species richness, low minnow species richness, no occurrences of sucker species or sensitive species, and low percentages of carnivorous or pioneer fish and simple lithophiles (fish that lay eggs on rocks). IBI scores for 2017 are lower than the previous survey (Appendix D). Lower fish diversity and number captured individuals could possibly be explained by higher water temperatures, which also increased the ambient conductivity (Kolz and Reynolds 1989; Burkhardt and Gutreuter, 1995), and so fish bio-regulatory processes and behavior were adversely affected for electroshock sampling. The same backpack shocker and operator were used for both surveys. Fish seining to offset the reduction of captured fish was prevented by coarse woody debris distributed throughout the sites on Pigeon Creek.

Table 4. Fish community metrics used to calculate the Index of Biotic Integrity and resulting scores for streams sampled within the proposed Seven Hills Mine in Warrick County, Indiana.

	AS1		AS2		AS3		AS5		AS6	
Parameter	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score
Number of Species	7	1	5	5	8	1	8	1	6	1
Number of Minnow Species	2	1	0	0	0	0	3	0	0	0
Number of Sunfish Species	4	1	3	3	4	1	1	1	3	1
Number of Sucker Species	0	0	0	0	0	0	0	0	0	0
Number of Sensitive Species	1	1	0	0	1	1	1	1	2	1
% Tolerant	30%	3	21%	5	39%	3	32%	3	0%	5
% Omnivore	17%	3	0%	0	0%	5	0%	5	0%	5
% Insectivore	0%	0	0%	0	0%	0	0%	0	0%	0
% Pioneer	N/A		17%	5	N/A		N/A		N/A	
% Carnivore	10%	1	N/A	0	17%	1	4%	1	10%	1
Total # Individuals	30	1	29	1	18	1	50	1	21	1
% Simple Lithophilic Individuals	0%	0	0%	0	0%	0	0%	0	0%	0
% Individuals with Deformities	0%	5	0%	5	0%	5	0%	5	0%	5
Totals		**17**		**24**		**18**		**18**		**20**
Qualitative Rating		**Very Poor**		**Poor**		**Very Poor**		**Very Poor**		**Very Poor**

*58-60=Excellent, 48-52=Good, 40-44=Fair, 28-34=Poor, 12-22=Very Poor, <12=No Fish

Green sunfish (*Lepomis cyanellus*), bluegill (*Lepomis macrochirus*), and spotted bass (*Micropterus punctalatus*) were found at all three sites. These are habitat gen eralists, and green sunfish are especially tolerant of adverse habitat conditions , such as sedimentation and low oxygen. Relatively populous species (>8 total individuals) included steelcolor shiners (*Cyprinella whipplei*), mosquitofish (*Gambusia affinis*), warmouth (*Lepomis gulosus*), long-eared sunfish (*Lepomis megalotis*), suckermouth minnow (*Phenacobius mirabilis*), and bluntnose minnow (*Pimephales notatus*). These species are typical inhabitants of pools and vegetation beds of small to medium -sized tributaries of the Ohio River. To a certain degree, t hey are able to tolerate habitat conditions found in Midwestern low-gradient streams, including warm water temperatures, relatively low oxygen, sedimentation, and non -point source pollution. Only two species which are known to be sensitive to and/or intolerant of pollution were captured: long-eared sunfish (*Lepomis megalotis*) and dusky darter (*Percina sciera*). No species captured in this survey is listed as threatened or endangered by the U.S. Fish and Wildlif e or the state of Indiana.

5. SUMMARY

Streams within the project area display several indicators of disturbance and poor water quality. They have been subject to channelization and show very little development of instream habitat and stable substrate. Water quality measurements show significant stressors to aquatic life in the form of high dissolved solids and low dissolved oxygen. Fish and macroinvertebrate communities at all sites reflect a very tolerant aquatic assemblage that is adapted to low gradient streams with inadequate habitat and water quality issues.

LITERATURECITED

Burkhardt, R. W., & Gutreuter, S. 1995. Improving electrofishing catch consistency by standardizing power. *North American Journal of Fisheries Management*, *15*(2), 375-381.

Eco-Tech Consultants, Inc. 2011a. Jurisdictional Waters Determination for the Proposed 2,351 Acre Seven Hills Surface Mine; Warrick County, Indiana; IDNR Surface Mining Application #S-00357

Eco-Tech Consultants, Inc. 2011b. Stream Sampling and Assessment Report; Proposed Seven Hills Surface Mine; Warrick County, Indiana; IDNR Surface Mining Application #S-00357

Eco-Tech Consultants, Inc. 2017. Seven Hills Mine Mitigation Sites HGM Memorandum of Findings; Warrick County Indiana. April 20, 2017

Indiana Department of Environmental Management (IDEM). 2006. Fish Community Sampling Program. Accessed November 2011 at: http://www.in.gov/idem/files/biostud_004fishcommsampprog.pdf.

U.S. EPA (Environmental Protection Agency). 2016. Field-Based Methods for Developing Aquatic Life Criteria for Specific Conductivity (Public Review Draft). U.S. Environmental Protection Agency, Washington, DC, EPA-822-R-07-010.

U.S. EPA. 2011. A Field-Based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams. Office of Research and Development, National Center for Environmental Assessment, Washington, DC. EPA/600/R-10/023F.

U.S. Fish and Wildlife Service. Electrofishing Tool Application. National Conservation Training Center. Accessed September 2017 at: https://nctc.fws.gov/courses/tools/electrofishing/page12146.html

U.S. Geological Survey, 2012, The StreamStats program for Indiana, accessed September 2017 at: http://water.usgs.gov/osw/streamstats/indiana.html.

Woods, Alan J., J. M. Omernik, C. S. Brockman, T. D. Gerber, W. D. Hosteter, and S. H. Azevedo. 1998. Ecoregions of Indiana and Ohio (Map poster). U.S. Geological Survey, Reston, VA., U.S. Geological Survey (map scale 1:1,000,000).

LITERATURE CITED

Burkhardt, R. W., & Gutreuter, S. 1995. Improving electrofishing catch consistency by standardizing power. *North American Journal of Fisheries Management*, *15*(2), 375-381.

Eco-Tech Consultants, Inc. 2011a. Jurisdictional Waters Determination for the Proposed 2,351 Acre Seven Hills Surface Mine; Warrick County, Indiana; IDNR Surface Mining Application #S-00357

Eco-Tech Consultants, Inc. 2011b. Stream Sampling and Assessment Report; Proposed Seven Hills Surface Mine; Warrick County, Indiana; IDNR Surface Mining Application #S-00357

Eco-Tech Consultants, Inc. 2017. Seven Hills Mine Mitigation Sites HGM Memorandum of Findings; Warrick County Indiana. April 20, 2017

Indiana Department of Environmental Management (IDEM). 2006. Fish Community Sampling Program. Accessed November 2011 at: http://www.in.gov/idem/files/biostud_004fishcommsampprog.pdf.

Indiana Department of Environmental Management (IDEM). 2011. Highland-Pigeon Creek TMDL. Accessed December 2011 at: http://www.in.gov/idem/nps/38 57.htm.

U.S. EPA (Environmental Protection Agency). 2011. A Field-Based Aquatic Life Benchmark for Conductivity in Central Appalachian Streams. Office of Research and Development, National Center for Environmental Assessment, Washington, DC. EPA/600/R-10/023F.

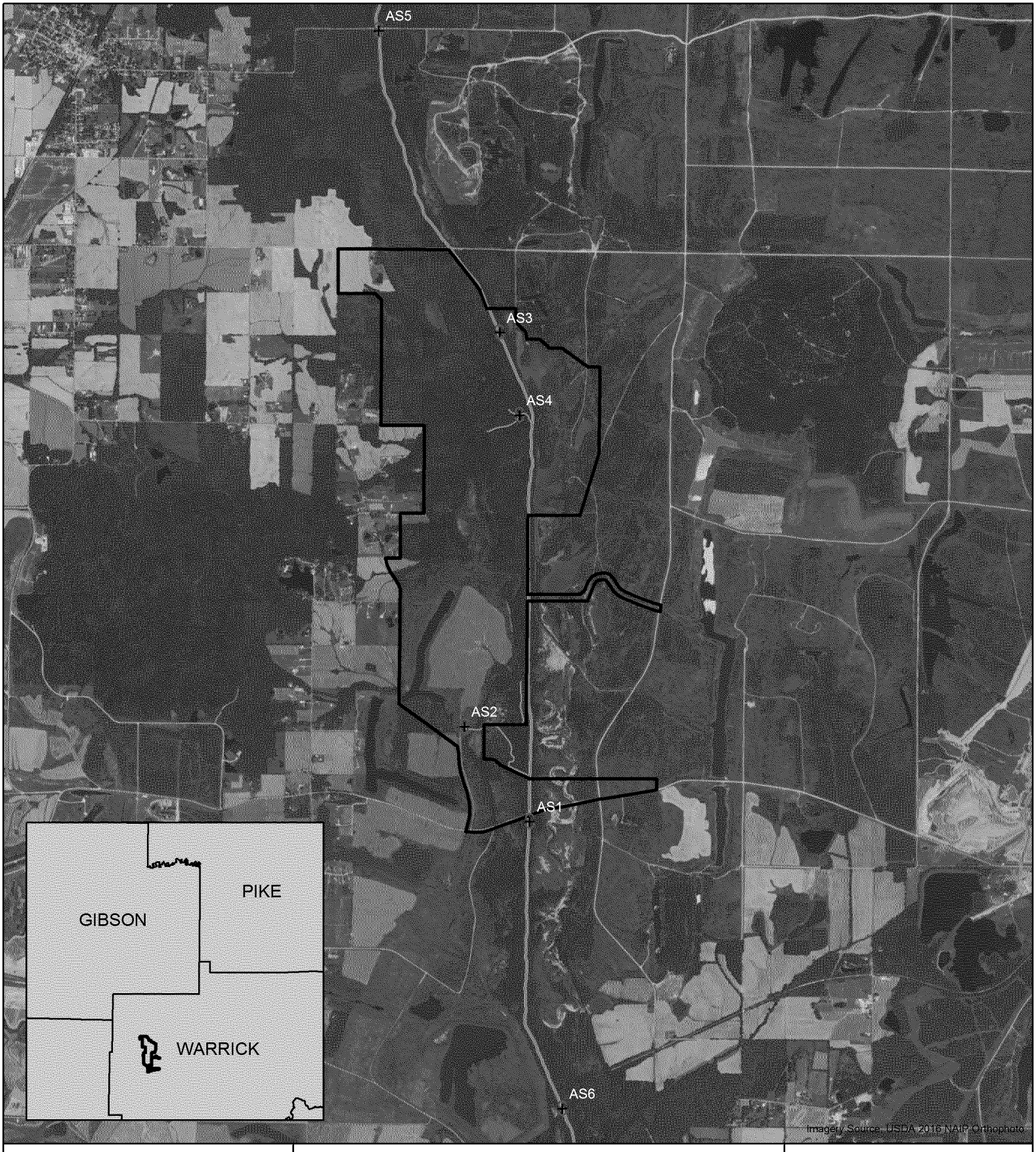
U.S. Fish and Wildlife Service. Electrofishing Tool Application. National Conservation Training Center. Accessed September 2017 at: https://nctc.fws.gov/courses/tools/electrofishing/page12146.html

U.S. Geological Survey, 2012, The StreamStats program for Indiana, accessed September 2017 at: http://water.usgs.gov/osw/streamstats/indiana.html.

Woods, Alan J., J. M. Omernik, C. S. Brockman, T. D. Gerber, W. D. Hosteter, and S. H. Azevedo. 1998. Ecoregions of Indiana and Ohio (Map poster). U.S. Geological Survey, Reston, VA., U.S. Geological Survey (map scale 1:1,000,000).

FIGURES.

FIGURE 1: PROJECT LOCATION MAP



Legend

- 2017 Aquatic Sample Point
- 2017 Permit Boundary
- Pigeon Creek

0 0.5 1 Miles

Figure 1:

Aquatic Sample Points

Peabody Seven Hills Mine
Warrick County, IN

Eco-Tech CONSULTANTS

Drawn by: RRN

Print Date: 9/15/2017

Project: LV2017025

APPENDIX A.

REPRESENTATIVE PHOTOGRAPHS

Photo 1. Sample point AS1 downstream view from bridge intersection

Photo 2. Sample point AS1 upstream view from bridge intersection

Photo 3. Sample point AS2 downstream view of pool habitat.

Photo 4. Sample point AS2 downstream view.

Photo 5. Sample point AS3 downstream view.

Photo 6. Sample point AS3 downstream view.

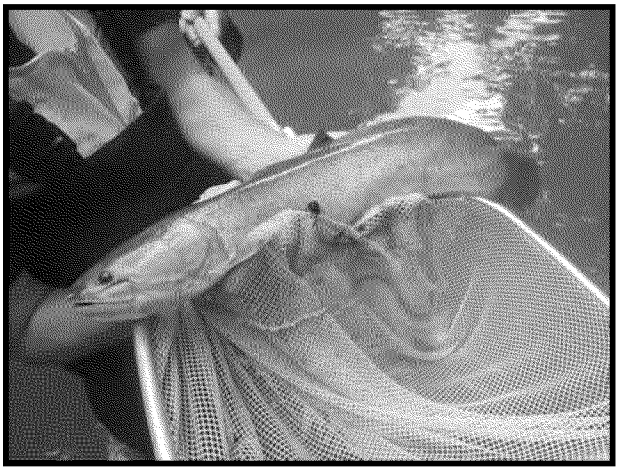


Photo 7. Bowfin (*Amia calva)* caught at AS3.

Photo 8. Sample point AS4 on survey date upstream view. Dry stream bed.

Photo 9. Sample point AS5 downstream view from underneath bridge.

Photo 10 Sample point AS5 upstream view from underneath bridge. Showing clay hardpan.

Photo 11. Sample point AS6 downstream view.

Photo 12. Sample point AS6 upstream view.

APPENDIX B.

EPA RBP FORMS AND SUPPLEMENTAL STREAM HABITAT FORMS

Appendix 10.4 Blank OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index) form (front)

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	bioSample #	Stream Name	Location
AS-1	—	Pigeon Creek	38.06617, -87.39379

Surveyor	Sample Date	County	Macro Sample Type	Habitat Complete	QHEI Score:
Eco-Tech	8/22/17	Warrick	MHAB, Fish	☑	52

1] *SUBSTRATE* Check ONLY Two predominant substrate TYPE BOXES; estimate % and check every type present

BEST TYPES (PREDOMINANT P R)	PRESENT P R	TOTAL %	OTHER TYPES (PREDOMINANT P R)	PRESENT P R	TOTAL %
☐☐ BLDR/SLABS [10]	☐☐	____	☑☐ HARDPAN [4]	☐☐	____
☐☐ BOULDER [9]	☐☐	____	☐☐ DETRITUS [3]	☐☐	____
☐☐ COBBLE [8]	☐☐	____	☐☐ MUCK [2]	☐☐	____
☐☐ GRAVEL [7]	☐☐	____	☑☐ SILT [2]	☐☐	____
☐☐ SAND [6]	☐☐	____	☐☐ ARTIFICIAL [0]	☐☐	____
☐☐ BEDROCK [5]	☐☐	____	(Score natural substrates; ignore sludge from point-sources)		

NUMBER OF BEST TYPES: ☐ 4 or more [2] ☐ 3 or less [0]

Check ONE (Or 2 & average)

ORIGIN
- ☐ LIMESTONE [1]
- ☐ TILLS [1]
- ☐ WETLANDS [0]
- ☑ HARDPAN [0]
- ☐ SANDSTONE [0]
- ☐ RIP/RAP [0]
- ☐ LACUSTRINE [0]
- ☐ SHALE [-1]
- ☐ COAL FINES [-2]

QUALITY
- STT ☑ HEAVY [-2]
- STT ☐ MODERATE [-1]
- LTT ☐ NORMAL [0]
- LTT ☐ FREE [1]

EXTENT OF EMBEDDEDNESS
- ☑ EXTENSIVE [-2]
- ☐ MODERATE [-1]
- ☐ NORMAL [0]
- ☐ NONE [1]

Substrate: 2 (Maximum 20)

Comments

2] *INSTREAM COVER* Indicate presence 0 to 3 and estimate percent: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed root wad in deep/fast water, or deep, well-defined, functional pools.)

% Amount		% Amount		% Amount	
10 1	UNDERCUT BANKS [1]	15 3	POOLS > 70cm [2]	— 0	OXBOWS, BACKWATERS [1]
5 2	OVERHANGING VEGETATION [1]	— 0	ROOTWADS [1]	— 0	AQUATIC MACROPHYTES [1]
20 2	SHALLOWS (IN SLOW WATER) [1]	5 1	BOULDERS [1]	5 1	LOGS OR WOODY DEBRIS [1]
5 1	ROOTMATS [1]				

AMOUNT Check ONE (Or 2 & average)
- ☐ EXTENSIVE > 75% [11]
- ☑ MODERATE 25 - 75% [7]
- ☐ SPARSE 5 - < 25% [3]
- ☐ NEARLY ABSENT < 5% [1]

Cover Maximum 20: 14

Comments

3] *CHANNEL MORPHOLOGY* Check ONE in each category (Or 2 & average)

SINUOSITY
- ☐ HIGH [4]
- ☐ MODERATE [3]
- ☐ LOW [2]
- ☑ NONE [1]

DEVELOPMENT
- ☐ EXCELLENT [7]
- ☐ GOOD [5]
- ☐ FAIR [3]
- ☑ POOR [1]

CHANNELIZATION
- ☐ NONE [6]
- ☑ RECOVERED [4]
- ☐ RECOVERING [3]
- ☐ RECENT OR NO RECOVERY [1]

STABILITY
- ☐ HIGH [3]
- ☐ MODERATE [2]
- ☑ LOW [1]

Channel Maximum 20: 7

Comments

4] *BANK EROSION AND RIPARIAN ZONE* Check ONE in each category for EACH BANK (Or 2 per bank & average)

EROSION (River right looking downstream)
- ☐☐ NONE/LITTLE [3]
- ☑☑ MODERATE [2]
- ☐☐ HEAVY/SEVERE [1]

RIPARIAN WIDTH
- ☑☑ WIDE > 50m [4]
- ☐☐ MODERATE 10-50m [3]
- ☐☐ NARROW 5-10m [2]
- ☐☐ VERY NARROW [1]
- ☐☐ NONE [0]

FLOOD PLAIN QUALITY
- ☑☑ FOREST, SWAMP [3]
- ☐☐ SHRUB OR OLD FIELD [2]
- ☐☐ RESIDENTIAL, PARK, NEW FIELD [1]
- ☐☐ FENCED PASTURE [1]
- ☐☐ OPEN PASTURE, ROWCROP [0]

- ☐☐ CONSERVATION TILLAGE [1]
- ☐☐ URBAN OR INDUSTRIAL [0]
- ☐☐ MINING/CONSTRUCTION [0]

Indicate predominant land use(s) past 100m riparian.

Riparian Maximum 10: 9

Comments

5] *POOL/GLIDE AND RIFFLE/RUN QUALITY*

MAXIMUM DEPTH Check ONE (ONLY!)
- ☑ > 1m [6]
- ☐ 0.7 - < 1m [4]
- ☐ 0.4 - < 0.7m [2]
- ☐ 0.2 - < 0.4m [1]
- ☐ < 0.2m [0]

CHANNEL WIDTH Check ONE (Or 2 & average)
- ☑ POOL WIDTH > RIFFLE WIDTH [2]
- ☐ POOL WIDTH = RIFFLE WIDTH [1]
- ☐ POOL WIDTH < RIFFLE WIDTH [0]

CURRENT VELOCITY Check ALL that apply
- ☐ TORRENTIAL [-1]
- ☐ VERY FAST [1]
- ☐ FAST [1]
- ☐ MODERATE [1]
- ☑ SLOW [1]
- ☐ INTERSTITIAL [-1]
- ☐ INTERMITTENT [-2]
- ☐ EDDIES [1]

Indicate for reach – pools and riffles.

Recreation Potential (Circle one and comment on back)
- ☐ Primary Contact
- ☐ Secondary Contact

Pool/Current Maximum 12: 9

Comments

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species:

☐ NO RIFFLE [metric = 0]

RIFFLE DEPTH
- ☐ BEST AREAS > 10cm [2]
- ☑ BEST AREAS 5 - 10cm [1]
- ☐ BEST AREAS < 5cm [metric = 0]

RUN DEPTH
- ☐ MAXIMUM > 50cm [2]
- ☑ MAXIMUM < 50cm [1]

RIFFLE/RUN SUBSTRATE Check ONE (Or 2 & average)
- ☐ STABLE (e.g., Cobble, Boulder) [2]
- ☐ MOD. STABLE (e.g., Large Gravel) [1]
- ☑ UNSTABLE (e.g., Fine Gravel, Sand) [0]

RIFFLE/RUN EMBEDDEDNESS
- ☐ NONE [2]
- ☑ LOW [1]
- ☐ MODERATE [0]
- ☐ EXTENSIVE [-1]

Riffle/Run Maximum 8: 3

Comments

6] *GRADIENT* (2.44 ft/mi)

DRAINAGE AREA (207.8 mi²)

- ☐ VERY LOW - LOW [2 - 4]
- ☐ MODERATE [6 - 10]
- ☐ HIGH - VERY HIGH [10 - 6]

%POOL: 40 %GLIDE: 35 %RUN: 20 %RIFFLE: 5

Gradient Maximum 10: 8

IDEM 07/06/10

Appendix 10.4 Blank OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index) form (back)

IDEM

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

COMMENT _____

A-CANOPY

- ☐ > 85% - Open
- ☐ 55% - < 85%
- ■ 30% - < 55%
- ☐ 10% - < 30%
- ☐ < 10% - Closed

B-AESTHETICS

- ☐ Nuisance algae
- ☐ Invasive macrophytes
- ■ Excess turbidity
- ☐ Discoloration
- ☐ Foam/Scum
- ☐ Oil sheen
- ■ Trash/Litter
- ☐ Nuisance odor
- ☐ Sludge deposits
- ☐ CSOs/SSOs/Outfalls

C-RECREATION

Area Depth

Pool: ☐ > 100 ft² ☐ > 3 ft

D-MAINTENANCE

- ☐ Public ☐ Private
- ☐ Active ☐ Historic
- Succession: ☐ Young ☐ Old
- ☐ Spray ☐ Islands ☐ Scoured
- Snag: ☐ Removed ☐ Modified
- Leveed: ☐ One sided ☐ Both banks
- ☐ Relocated ☐ Cutoffs
- Bedload: ☐ Moving ☐ Stable
- ☐ Armoured ☐ Slumps
- ☐ Impounded ☐ Desiccated
- ☐ Flood control ☐ Drainage

E-ISSUES

- ☐ WWTP ☐ CSO ☐ NPDES
- ☐ Industry ☐ Urban
- ☐ Hardened ☐ Dirt & Grime
- ☐ Contaminated ☐ Landfill
- BMPs: ☐ Construction ☐ Sediment
- ☐ Logging ☐ Irrigation ☐ Cooling
- Erosion: ☐ Bank ☐ Surface
- ☐ False bank ☐ Manure ☐ Lagoon
- ☐ Wash H_2O ☐ Tile ☐ H_2O Table
- Mine: ☐ Acid ☐ Quarry
- Flow: ☐ Natural ☐ Stagnant
- ☐ Wetland ☐ Park ☐ Golf
- ☐ Lawn ☐ Home
- ☐ Atmospheric deposition

Looking upstream (> 10m, 3 readings; < 10m, 1 reading in middle); Round to the nearest whole percent

	Left	Middle	Right	Total Average
% open	___ %	___ %	___ %	___ %

Stream Drawing: ASI

CSEN 07/05/19

AS1 (3c NORTH)

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS

See Attached

STREAM NAME		LOCATION
STATION # _____	REACH ID# _____	STREAM CLASS
UTM N _____	UTM E _____	RIVER BASIN
STORET #		AGENCY
INVESTIGATORS		
FORM COMPLETED BY	DATE _____ TIME _____ PM	REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 6	20 19 18 17 16	15 14 13 12 11	10 9 8 7 (6)	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE 6	20 19 18 17 16	15 14 13 12 11	10 9 8 7 (6)	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE 12	20 19 18 17 16	15 14 13 (12) 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 10	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 19	20 (19) 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 6	20 19 18 17 16	15 14 13 12 11	10 9 8 7 (6)	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE 1	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 (1) 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 9 (LB)	Left Bank 10 (9)	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 (9)	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 8 (LB)	Left Bank 10 9	(8) 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	(8) 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 9 (LB)	Left Bank 10 (9)	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 (9)	8 7 6	5 4 3	2 1 0

Total Score 112

Appendix 10.4 Blank OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index) form (front)

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

IDEM

Sample #	bioSample #	Stream Name	Location
AS-2	—	Unnamed Tributary to Pigeon Cr.	38.103602, -87.406125

Surveyor	Sample Date	County	Macro Sample Type	▩ Habitat Complete	QHEI Score:
CortecH	8/22/17	Warrick	MHAB/Fish		45

1] *SUBSTRATE* Check ONLY Two predominant substrate TYPE BOXES; estimate % and check every type present

BEST TYPES	PREDOMINANT P	R	PRESENT	TOTAL %
BLDR/SLABS [10]	☐	☐	☐	____
BOULDER [9]	☐	☐	☐	____
COBBLE [8]	☐	☐	▩	____
GRAVEL [7]	☐	☐	▩	____
SAND [6]	☐	☐	☐	____
BEDROCK [5]	☐	☐	☐	____

OTHER TYPES	PREDOMINANT P	R	PRESENT	TOTAL %
HARDPAN [4]	☐	☐	▩	____
DETRITUS [3]	☐	☐	☐	____
MUCK [2]	☐	☐	☐	____
SILT [2]	☐	☐	☐	____
ARTIFICIAL [0]	☐	☐	☐	____

(Score natural substrates; ignore sludge from point-sources)

NUMBER OF BEST TYPES: ▩ 4 or more [2] ☐ 3 or less [0]

ORIGIN (Check ONE (Or 2 & average))
- ☐ LIMESTONE [1]
- ☐ TILLS [1]
- ☐ WETLANDS [0]
- ☐ HARDPAN [0]
- ☐ SANDSTONE [0]
- ☐ RIP/RAP [0]
- ☐ LACUSTRINE [0]
- ☐ SHALE [-1]
- ☐ COAL FINES [-2]

QUALITY (Check ONE (Or 2 & average))
- STILL: ▩ HEAVY [-2]; ☐ MODERATE [-1]
- LOTIC: ☐ NORMAL [0]; ☐ FREE [1]
- ☐ EXTENSIVE [-2]
- ▩ MODERATE [-1]
- ☐ NORMAL [0]
- ☐ NONE [1]

Substrate Maximum 20: 4

Comments

2] *INSTREAM COVER* Indicate presence 0 to 3 and estimate percent: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed root wad in deep/fast water, or deep, well-defined, functional pools.)

% Amount		
20 2	UNDERCUT BANKS [1]	
40 2	OVERHANGING VEGETATION [1]	
40 3	SHALLOWS (IN SLOW WATER) [1]	
___ 1	ROOTMATS [1]	
___ 1	POOLS > 70cm [2]	
___ 1	ROOTWADS [1]	
___ 2	BOULDERS [1]	
___ 0	OXBOWS, BACKWATERS [1]	
___ ___	AQUATIC MACROPHYTES [1]	
10 2	LOGS OR WOODY DEBRIS [1]	

AMOUNT (Check ONE (Or 2 & average))
- ☐ EXTENSIVE > 75% [11]
- ☐ MODERATE 25 - 75% [7]
- ☐ SPARSE 5 - < 25% [3]
- ▩ NEARLY ABSENT < 5% [1]

Cover Maximum 20: 10

Comments

3] *CHANNEL MORPHOLOGY* Check ONE in each category (Or 2 & average)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY
☐ HIGH [4]	☐ EXCELLENT [7]	☐ NONE [6]	☐ HIGH [3]
☐ MODERATE [3]	☐ GOOD [5]	☐ RECOVERED [4]	☐ MODERATE [2]
▩ LOW [2]	▩ FAIR [3]	☐ RECOVERING [3]	▩ LOW [1]
☐ NONE [1]	☐ POOR [1]	▩ RECENT OR NO RECOVERY [1]	

Channel Maximum 20: 7

Comments

4] *BANK EROSION AND RIPARIAN ZONE* Check ONE in each category for EACH BANK (Or 2 per bank & average)

River right looking downstream

L	R	EROSION
☐	☐	NONE/LITTLE [3]
▩	▩	MODERATE [2]
☐	☐	HEAVY/SEVERE [1]

L	R	RIPARIAN WIDTH
▩	▩	WIDE > 50m [4]
☐	☐	MODERATE 10-50m [3]
☐	☐	NARROW 5-10m [2]
☐	☐	VERY NARROW [1]
☐	☐	NONE [0]

L	R	FLOOD PLAIN QUALITY
☐	☐	FOREST, SWAMP [3]
▩	▩	SHRUB OR OLD FIELD [2]
☐	☐	RESIDENTIAL, PARK, NEW FIELD [1]
☐	☐	FENCED PASTURE [1]
☐	☐	OPEN PASTURE, ROWCROP [0]

L	R	
☐	☐	CONSERVATION TILLAGE [1]
☐	☐	URBAN OR INDUSTRIAL [0]
☐	☐	MINING/CONSTRUCTION [0]

Indicate predominant land use(s) past 100m riparian.

Riparian Maximum 10: 8

Comments

5] *POOL/GLIDE AND RIFFLE/RUN QUALITY*

MAXIMUM DEPTH (Check ONE (ONLY!))
- ☐ > 1m [6]
- ☐ 0.7 - < 1m [4]
- ▩ 0.4 - < 0.7m [2]
- ☐ 0.2 - < 0.4m [1]
- ☐ < 0.2m [0]

CHANNEL WIDTH (Check ONE (Or 2 & average))
- ☐ POOL WIDTH > RIFFLE WIDTH [2]
- ▩ POOL WIDTH = RIFFLE WIDTH [1]
- ☐ POOL WIDTH < RIFFLE WIDTH [0]

CURRENT VELOCITY (Check ALL that apply)
- ☐ TORRENTIAL [-1]
- ▩ SLOW [1]
- ☐ VERY FAST [1]
- ☐ INTERSTITIAL [-1]
- ☐ FAST [1]
- ☐ INTERMITTENT [-2]
- ☐ MODERATE [1]
- ☐ EDDIES [1]

Indicate for reach – pools and riffles.

Recreation Potential (Circle one and comment on back)
- ☐ Primary Contact
- ☐ Secondary Contact

Pool/Current Maximum 12: 4

Comments

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species:

☐ NO RIFFLE [metric = 0]

RIFFLE DEPTH
- ☐ BEST AREAS > 10cm [2]
- ▩ BEST AREAS 5 - 10cm [1]
- ☐ BEST AREAS < 5cm [metric = 0]

RUN DEPTH
- ☐ MAXIMUM > 50cm [2]
- ▩ MAXIMUM < 50cm [1]

RIFFLE/RUN SUBSTRATE (Check ONE (Or 2 & average))
- ☐ STABLE (e.g., Cobble, Boulder) [2]
- ▩ MOD. STABLE (e.g., Large Gravel) [1]
- ☐ UNSTABLE (e.g., Fine Gravel, Sand) [0]

RIFFLE/RUN EMBEDDEDNESS
- ☐ NONE [2]
- ▩ LOW [1]
- ☐ MODERATE [0]
- ☐ EXTENSIVE [-1]

Riffle/Run Maximum 8: 4

Comments

6] *GRADIENT* (66.1 ft/mi)

- ☐ VERY LOW - LOW [2 – 4]
- ▩ MODERATE [6 - 10]
- ☐ HIGH - VERY HIGH [10 - 6]

%POOL: 40 %GLIDE: 40 %RUN: 10 %RIFFLE: 10

DRAINAGE AREA (0.91 mi²)

Gradient Maximum 10: 6

IDEM 07/06/10

BARRIER DAM PRESENT
SNAGGES
RUN ends Abruptly at Debris Pile

IDEM

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

COMMENT

A-CANOPY
- ☐ > 85% - Open
- ☐ 55% - < 85%
- ☐ 30% - < 55%
- ☒ 10% - < 30%
- ☐ < 10% - Closed

B-AESTHETICS
- ☐ Nuisance algae
- ☐ Invasive macrophytes
- ☒ Excess turbidity
- ☐ Discoloration
- ☐ Foam/Scum
- ☐ Oil sheen
- ☐ Trash/Litter
- ☐ Nuisance odor
- ☐ Sludge deposits
- ☐ CSOs/SSOs/Outfalls

C-RECREATION

	Area	Depth
Pool:	☐ > 100 ft²	☐ > 3 ft

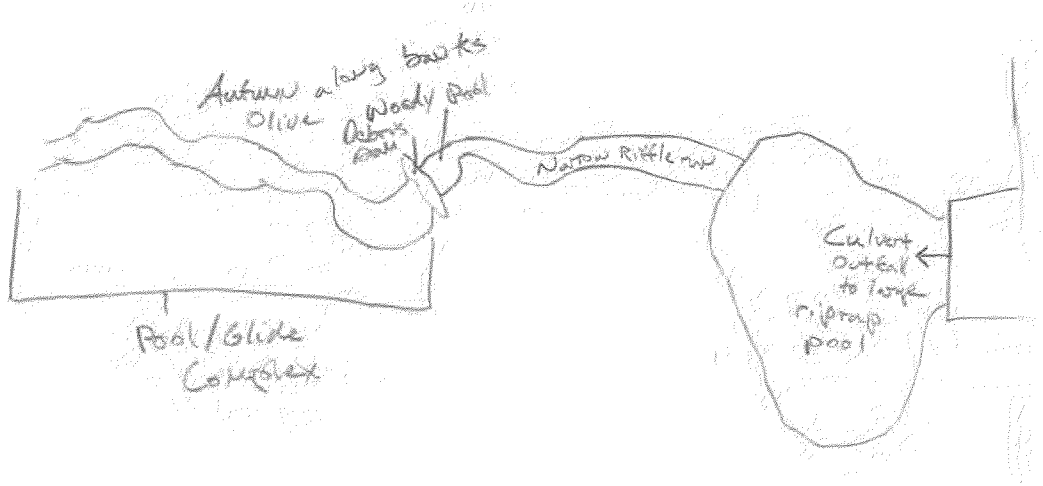
D-MAINTENANCE
- ☐ Public ☐ Private
- ☐ Active ☐ Historic
- Succession: ☐ Young ☐ Old
- ☐ Spray ☐ Islands ☐ Scoured
- Snag: ☐ Removed ☐ Modified
- Leveed: ☐ One sided ☐ Both banks
- ☐ Relocated ☐ Cutoffs
- Bedload: ☐ Moving ☐ Stable
- ☐ Armoured ☐ Slumps
- ☐ Impounded ☐ Desiccated
- ☐ Flood control ☐ Drainage

E-ISSUES
- ☐ WWTP ☐ CSO ☐ NPDES
- ☐ Industry ☐ Urban
- ☐ Hardened ☐ Dirt & Grime
- ☐ Contaminated ☐ Landfill
- BMPs: ☐ Construction ☐ Sediment
- ☐ Logging ☐ Irrigation ☐ Cooling
- Erosion: ☐ Bank ☐ Surface
- ☐ False bank ☐ Manure ☐ Lagoon
- ☐ Wash H_2O ☐ Tile ☐ H_2O Table
- Mine: ☐ Acid ☐ Quarry
- Flow: ☐ Natural ☐ Stagnant
- ☐ Wetland ☐ Park ☐ Golf
- ☐ Lawn ☐ Home
- ☐ Atmospheric deposition

Looking upstream (> 10m, 3 readings; < 10m, 1 reading in middle); Round to the nearest whole percent

	Left	Middle	Right	Total Average
% open	%	%	%	%
	X	X	X	

Stream Drawing: AS2



IDEM 07/06/10

AS2 (4th NORTH)

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS

See Attached

STREAM NAME		LOCATION
STATION #	REACH ID#	STREAM CLASS
UTM N	UTM E	RIVER BASIN
STORET #		AGENCY
INVESTIGATORS		
FORM COMPLETED BY	DATE TIME PM	REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 8	20 19 18 17 16	15 14 13 12 11	10 9 (8) 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE 10	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE 5	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	(5) 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 10	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 12	20 (19) 18 17 16	15 14 13 (12) 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 6	20 19 18 17 16	15 14 13 12 11	10 9 8 7 **6**	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE 5	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	**5** 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 4 (LB)	Left Bank 10 9	8 7 6	5 **4** 3	2 1 0
SCORE 4 (RB)	Right Bank 10 9	8 7 6	5 **4** 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 6 (LB)	Left Bank 10 9	8 7 **6**	5 4 3	2 1 0
SCORE 6 (RB)	Right Bank 10 9	8 7 **6**	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.
SCORE 6 (LB)	Left Bank 10 9	8 7 **6**	5 4 3	2 1 0
SCORE 6 (RB)	Right Bank 10 9	8 7 **6**	5 4 3	2 1 0

Total Score 88

Appendix 10.4 Blank OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index) form (front)

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

IDEM

Sample #	bioSample #	Stream Name	Location
AS-3	—	Pigeon Creek	38.136306, -87.402111

Surveyor	Sample Date	County	Macro Sample Type	Habitat Complete	QHEI Score:
Eco-Tech	8/22/19	Warrick	MHAB/Fish	☒	48

1] *SUBSTRATE* Check ONLY Two predominant substrate TYPE BOXES; estimate % and check every type present

BEST TYPES	PREDOMINANT P	PREDOMINANT R	PRESENT	TOTAL %
BLDR/SLABS [10]	☐	☐	☐	____
BOULDER [9]	☐	☐	☐	____
COBBLE [8]	☐	☐	☐	____
GRAVEL [7]	☐	☐	☐	____
SAND [6]	☒	☐	☐	20
BEDROCK [5]	☐	☐	☐	____

OTHER TYPES	PREDOMINANT P	PREDOMINANT R	PRESENT	TOTAL %
HARDPAN [4]	☒	☐	☐	30
DETRITUS [3]	☐	☐	☐	____
MUCK [2]	☐	☐	☒	____
SILT [2]	☐	☐	☒	____
ARTIFICIAL [0]	☐	☐	☐	____

(Score natural substrates; ignore sludge from point-sources)

NUMBER OF BEST TYPES: ☐ 4 or more [2] ☐ 3 or less [0]

Check ONE (Or 2 & average)

ORIGIN
- ☐ LIMESTONE [1]
- ☐ TILLS [1]
- ☐ WETLANDS [0]
- ☒ HARDPAN [0]
- ☐ SANDSTONE [0]
- ☐ RIP/RAP [0]
- ☐ LACUSTRINE [0]
- ☐ SHALE [-1]
- ☐ COAL FINES [-2]

QUALITY

STILT
- ☒ HEAVY [-2]
- ☐ MODERATE [-1]
- ☐ NORMAL [0]
- ☐ FREE [1]

INCREASERS
- ☒ EXTENSIVE [-2]
- ☐ MODERATE [-1]
- ☐ NORMAL [0]
- ☐ NONE [1]

Substrate: 6 (Maximum 20)

Comments

2] *INSTREAM COVER* Indicate presence 0 to 3 and estimate percent: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed root wad in deep/fast water, or deep, well-defined, functional pools.)

%	Amount		%	Amount		%	Amount	
0	0	UNDERCUT BANKS [1]	60	2	POOLS > 70cm [2]	0	0	OXBOWS, BACKWATERS [1]
5	1	OVERHANGING VEGETATION [1]	5	1	ROOTWADS [1]	0	0	AQUATIC MACROPHYTES [1]
15	1	SHALLOWS (IN SLOW WATER) [1]	0	0	BOULDERS [1]	10	1	LOGS OR WOODY DEBRIS [1]
5	1	ROOTMATS [1]						

AMOUNT Check ONE (Or 2 & average)
- ☐ EXTENSIVE > 75% [11]
- ☐ MODERATE 25 - 75% [7]
- ☒ SPARSE 5 - < 25% [3]
- ☐ NEARLY ABSENT < 5% [1]

Cover Maximum 20: 10

Comments

3] *CHANNEL MORPHOLOGY* Check ONE in each category (Or 2 & average)

SINUOSITY
- ☐ HIGH [4]
- ☐ MODERATE [3]
- ☐ LOW [2]
- ☒ NONE [1]

DEVELOPMENT
- ☐ EXCELLENT [7]
- ☐ GOOD [5]
- ☐ FAIR [3]
- ☒ POOR [1]

CHANNELIZATION
- ☐ NONE [6]
- ☒ RECOVERED [4]
- ☐ RECOVERING [3]
- ☐ RECENT OR NO RECOVERY [1]

STABILITY
- ☐ HIGH [3]
- ☐ MODERATE [2]
- ☒ LOW [1]

Channel Maximum 20: 7

Comments

4] *BANK EROSION AND RIPARIAN ZONE* Check ONE in each category for EACH BANK (Or 2 per bank & average)

River right looking downstream

EROSION (L R)
- ☒ ☒ NONE/LITTLE [3]
- ☐ ☐ MODERATE [2]
- ☐ ☐ HEAVY/SEVERE [1]

RIPARIAN WIDTH (L R)
- ☒ ☒ WIDE > 50m [4]
- ☐ ☐ MODERATE 10-50m [3]
- ☐ ☐ NARROW 5-10m [2]
- ☐ ☐ VERY NARROW [1]
- ☐ ☐ NONE [0]

FLOOD PLAIN QUALITY (L R)
- ☒ ☒ FOREST, SWAMP [3]
- ☐ ☐ SHRUB OR OLD FIELD [2]
- ☐ ☐ RESIDENTIAL, PARK, NEW FIELD [1]
- ☐ ☐ FENCED PASTURE [1]
- ☐ ☐ OPEN PASTURE, ROWCROP [0]

(L R)
- ☐ ☐ CONSERVATION TILLAGE [1]
- ☐ ☐ URBAN OR INDUSTRIAL [0]
- ☐ ☐ MINING/CONSTRUCTION [0]

Indicate predominant land use(s) past 100m riparian.

Riparian Maximum 10: 10

Comments

5] *POOL/GLIDE AND RIFFLE/RUN QUALITY*

MAXIMUM DEPTH Check ONE (ONLY!)
- ☒ > 1m [6]
- ☐ 0.7 - < 1m [4]
- ☐ 0.4 - < 0.7m [2]
- ☐ 0.2 - < 0.4m [1]
- ☐ < 0.2m [0]

CHANNEL WIDTH Check ONE (Or 2 & average)
- ☒ POOL WIDTH > RIFFLE WIDTH [2]
- ☐ POOL WIDTH = RIFFLE WIDTH [1]
- ☐ POOL WIDTH < RIFFLE WIDTH [0]

CURRENT VELOCITY Check ALL that apply
- ☐ TORRENTIAL [-1]
- ☐ VERY FAST [1]
- ☐ FAST [1]
- ☐ MODERATE [1]
- ☐ SLOW [1]
- ☒ INTERSTITIAL [-1]
- ☐ INTERMITTENT [-2]
- ☐ EDDIES [1]

Indicate for reach – pools and riffles.

Recreation Potential (Circle one and comment on back)
- ☐ Primary Contact
- ☐ Secondary Contact

Pool/Current Maximum 12: 7

Comments

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species:

☐ NO RIFFLE [metric = 0]

RIFFLE DEPTH Check ONE (Or 2 & average)
- ☐ BEST AREAS > 10cm [2]
- ☐ BEST AREAS 5 - 10cm [1]
- ☐ BEST AREAS < 5cm [metric = 0]

RUN DEPTH
- ☐ MAXIMUM > 50cm [2]
- ☐ MAXIMUM < 50cm [1]

RIFFLE/RUN SUBSTRATE
- ☐ STABLE (e.g., Cobble, Boulder) [2]
- ☐ MOD. STABLE (e.g., Large Gravel) [1]
- ☒ UNSTABLE (e.g., Fine Gravel, Sand) [0]

RIFFLE/RUN EMBEDDEDNESS
- ☐ NONE [2]
- ☐ LOW [1]
- ☒ MODERATE [0]
- ☐ EXTENSIVE [-1]

Riffle/Run Maximum 8: 0

Comments

6] *GRADIENT* (7.64 ft/mi)

DRAINAGE AREA (192.7 mi²)

- ☐ VERY LOW - LOW [2 – 4]
- ☒ MODERATE [6 - 10]
- ☐ HIGH - VERY HIGH [10 - 6]

%POOL: 40 %GLIDE: 60 %RUN: X %RIFFLE: X

Gradient Maximum 10: 8

IDEM 07/06/10

Appendix 10.4 Blank OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index) form (back)

IDEM

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

COMMENT _____

A-CANOPY
- ☒ > 85%-Open
- ☐ 55% - < 85%
- ☐ 30% - < 55%
- ☐ 10% - < 30%
- ☐ < 10%-Closed

B-AESTHETICS
- ☐ Nuisance algae
- ☐ Invasive macrophytes
- ☐ Excess turbidity
- ☐ Discoloration
- ☐ Foam/Scum
- ☐ Oil sheen
- ☐ Trash/Litter
- ☐ Nuisance odor
- ☐ Sludge deposits
- ☐ CSOs/SSOs/Outfalls

C-RECREATION
Area Depth
Pool: ☐ > 100 ft² ☐ > 3 ft

D-MAINTENANCE
- ☐ Public ☐ Private
- ☐ Active ☐ Historic
- Succession: ☐ Young ☐ Old
- ☐ Spray ☐ Islands ☐ Scoured
- Snag: ☐ Removed ☐ Modified
- Levee: ☐ One sided ☐ Both banks
- ☐ Relocated ☐ Cutoffs
- Bedload: ☐ Moving ☐ Stable
- ☐ Armoured ☐ Slumps
- ☐ Impounded ☐ Desiccated
- ☐ Flood control ☐ Drainage

E-ISSUES
- ☐ WWTP ☐ CSO ☐ NPDES
- ☐ Industry ☐ Urban
- ☐ Hardened ☐ Dirt & Grime
- ☐ Contaminated ☐ Landfill
- BMPs: ☐ Construction ☐ Sediment
- ☐ Logging ☐ Irrigation ☐ Cooling
- Erosion: ☐ Bank ☐ Surface
- ☐ False bank ☐ Manure ☐ Lagoon
- ☐ Wash H_2O ☐ Tile ☐ H_2O Table
- Mine: ☐ Acid ☐ Quarry
- Flow: ☐ Natural ☐ Stagnant
- ☐ Wetland ☐ Park ☐ Golf
- ☐ Lawn ☐ Home
- ☐ Atmospheric deposition

Looking upstream (> 10m, 3 readings; < 10m, 1 reading in middle); Round to the nearest whole percent

	Left	Middle	Right	Total Average
% open	___ %	___ %	___ %	___ %

Stream Drawing: AS3

IDEM 07/06/10

A

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS

See Attached

STREAM NAME		LOCATION
STATION # REACH ID#		STREAM CLASS
UTM N UTM E		RIVER BASIN
STORET #		AGENCY
INVESTIGATORS		
FORM COMPLETED BY	DATE _____ TIME _ PM	REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 5	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	(5) 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE 8	20 19 18 17 16	15 14 13 12 11	10 9 (8) 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE 14	20 19 18 17 16	15 (14) 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 10	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 16	20 19 18 17 (16)	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 8	20 19 18 17 16	15 14 13 12 11	10 9 (8) 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE 1	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 (1) 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 6 (LB)	Left Bank 10 9	8 7 (6)	5 4 3	2 1 0
SCORE 6 (RB)	Right Bank 10 9	8 7 (6)	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 5 (LB)	Left Bank 10 9	8 7 6	(5) 4 3	2 1 0
SCORE 5 (RB)	Right Bank 10 9	8 7 6	(5) 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 9 (LB)	Left Bank 10 (9)	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 (9)	8 7 6	5 4 3	2 1 0

Total Score 102

Appendix 10.4 Blank OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index) form (front)

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

IDEM

Sample #	bioSample #	Stream Name	Location
AS-5	—	Pigeon Cr.	38.16182, -87.41539 76

Surveyor	Sample Date	County	Macro Sample Type	☒ Habitat Complete	QHEI Score:
EcoTech	8/21/17	Warrick	MHAB, Fish		53

1] *SUBSTRATE* Check ONLY Two predominant substrate TYPE BOXES; estimate % and check every type present

BEST TYPES	PREDOMINANT P	PREDOMINANT R	PRESENT	TOTAL %
BLDR/SLABS [10]	☐	☐	☐	
BOULDER [9]	☐	☐	☐	
COBBLE [8]	☐	☐	☐	
GRAVEL [7]	☐	☐	☐	
SAND [6]	☒	☒	☐	60
BEDROCK [5]	☐	☐	☐	

OTHER TYPES	PREDOMINANT P	PREDOMINANT R	PRESENT	TOTAL %
HARDPAN [4]	☐	☒	☐	15
DETRITUS [3]	☐	☐	☐	
MUCK [2]	☐	☐	☐	
SILT [2]	☐	☒	☐	25
ARTIFICIAL [0]	☐	☐	☐	

(Score natural substrates; ignore sludge from point-sources)

NUMBER OF BEST TYPES: ☐ 4 or more [2] ☐ 3 or less [0]

Check ONE (Or 2 & average)

ORIGIN
- ☐ LIMESTONE [1]
- ☐ TILLS [1]
- ☐ WETLANDS [0]
- ☒ HARDPAN [0]
- ☐ SANDSTONE [0]
- ☐ RIP/RAP [0]
- ☐ LACUSTRINE [0]
- ☐ SHALE [-1]
- ☐ COAL FINES [-2]

QUALITY

SILTATION
- ☒ HEAVY [-2]
- ☐ MODERATE [-1]
- ☐ NORMAL [0]
- ☐ FREE [1]

EMBEDDEDNESS
- ☒ EXTENSIVE [-2]
- ☐ MODERATE [-1]
- ☐ NORMAL [0]
- ☐ NONE [1]

Substrate: 6 (Maximum 20)

Comments

2] *INSTREAM COVER* Indicate presence 0 to 3 and estimate percent: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed root wad in deep/fast water, or deep, well-defined, functional pools.)

	%	Amount
UNDERCUT BANKS [1]		0
OVERHANGING VEGETATION [1]	1	1
SHALLOWS (IN SLOW WATER) [1]	10	1
ROOTMATS [1]		0
POOLS > 70cm [2]	10	2
ROOTWADS [1]		0
BOULDERS [1]		0
OXBOWS, BACKWATERS [1]		0
AQUATIC MACROPHYTES [1]		0
LOGS OR WOODY DEBRIS [1]	10	2

AMOUNT Check ONE (Or 2 & average)
- ☐ EXTENSIVE > 75% [11]
- ☒ MODERATE 25 - 75% [7]
- ☐ SPARSE 5 - < 25% [3]
- ☐ NEARLY ABSENT < 5% [1]

Cover Maximum 20: 12

Comments

3] *CHANNEL MORPHOLOGY* Check ONE in each category (Or 2 & average)

SINUOSITY
- ☐ HIGH [4]
- ☐ MODERATE [3]
- ☐ LOW [2]
- ☒ NONE [1]

DEVELOPMENT
- ☐ EXCELLENT [7]
- ☐ GOOD [5]
- ☐ FAIR [3]
- ☒ POOR [1]

CHANNELIZATION
- ☐ NONE [6]
- ☒ RECOVERED [4]
- ☐ RECOVERING [3]
- ☐ RECENT OR NO RECOVERY [1]

STABILITY
- ☐ HIGH [3]
- ☒ MODERATE [2]
- ☐ LOW [1]

Channel Maximum 20: 8

Comments

4] *BANK EROSION AND RIPARIAN ZONE* Check ONE in each category for EACH BANK (Or 2 per bank & average)

River right looking downstream

EROSION L	EROSION R	
☒	☒	NONE/LITTLE [3]
☐	☐	MODERATE [2]
☐	☐	HEAVY/SEVERE [1]

RIPARIAN WIDTH L	RIPARIAN WIDTH R	
☒	☒	WIDE > 50m [4]
☐	☐	MODERATE 10-50m [3]
☐	☐	NARROW 5-10m [2]
☐	☐	VERY NARROW [1]
☐	☐	NONE [0]

FLOOD PLAIN QUALITY L	FLOOD PLAIN QUALITY R	
☒	☒	FOREST, SWAMP [3]
☐	☐	SHRUB OR OLD FIELD [2]
☐	☐	RESIDENTIAL, PARK, NEW FIELD [1]
☐	☐	FENCED PASTURE [1]
☐	☐	OPEN PASTURE, ROWCROP [0]

L	R	
☐	☐	CONSERVATION TILLAGE [1]
☐	☐	URBAN OR INDUSTRIAL [0]
☐	☐	MINING/CONSTRUCTION [0]

Indicate predominant land use(s) past 100m riparian.

Riparian Maximum 10: 10

Comments

5] *POOL/GLIDE AND RIFFLE/RUN QUALITY*

MAXIMUM DEPTH Check ONE (ONLY!)
- ☐ > 1m [6]
- ☒ 0.7 - < 1m [4]
- ☐ 0.4 - < 0.7m [2]
- ☐ 0.2 - < 0.4m [1]
- ☐ < 0.2m [0]

CHANNEL WIDTH Check ONE (Or 2 & average)
- ☐ POOL WIDTH > RIFFLE WIDTH [2]
- ☒ POOL WIDTH = RIFFLE WIDTH [1]
- ☐ POOL WIDTH < RIFFLE WIDTH [0]

CURRENT VELOCITY Check ALL that apply
- ☐ TORRENTIAL [-1]
- ☐ VERY FAST [1]
- ☒ FAST [1]
- ☐ MODERATE [1]
- ☒ SLOW [1]
- ☐ INTERSTITIAL [-1]
- ☐ INTERMITTENT [-2]
- ☐ EDDIES [1]

Indicate for reach – pools and riffles.

Recreation Potential (Circle one and comment on back)
- ☐ Primary Contact
- ☐ Secondary Contact

Pool/Current Maximum 12: 7

Comments

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species:

☐ NO RIFFLE [metric = 0]

RIFFLE DEPTH Check ONE (Or 2 & average)
- ☒ BEST AREAS > 10cm [2]
- ☐ BEST AREAS 5 - 10cm [1]
- ☐ BEST AREAS < 5cm [metric = 0]

RUN DEPTH
- ☐ MAXIMUM > 50cm [2]
- ☒ MAXIMUM < 50cm [1]

RIFFLE/RUN SUBSTRATE
- ☐ STABLE (e.g., Cobble, Boulder) [2]
- ☐ MOD. STABLE (e.g., Large Gravel) [1]
- ☒ UNSTABLE (e.g., Fine Gravel, Sand) [0]

RIFFLE/RUN EMBEDDEDNESS
- ☐ NONE [2]
- ☐ LOW [1]
- ☐ MODERATE [0]
- ☒ EXTENSIVE [-1]

Riffle/Run Maximum 8: 2

Comments

6] *GRADIENT* (2.64 ft/mi) .05%
- ☐ VERY LOW - LOW [2 – 4]
- ☒ MODERATE [6 - 10]
- ☐ HIGH - VERY HIGH [10 - 6]

DRAINAGE AREA (1.92 mi²)

%POOL: 35 %GLIDE: 30 %RUN: 25 %RIFFLE: 10

Gradient Maximum 10: 8

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Appendix 10.4 Blank OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index) form (back)

IDEM

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

COMMENT _____

_____

A-CANOPY
- ☐ > 85%-Open
- ☐ 55%- < 85%
- ☐ 30%- < 55%
- ☐ 10%- < 30%
- ☐ < 10%-Closed

B-AESTHETICS
- ☐ Nuisance algae
- ☐ Invasive macrophytes
- ☐ Excess turbidity
- ☐ Discoloration
- ☒ Foam/Scum
- ☐ Oil sheen
- ☒ Trash/Litter
- ☒ Nuisance odor
- ☒ Sludge deposits
- ☐ CSOs/SSOs/Outfalls

C-RECREATION

Area Depth

Pool: ☒ > 100 ft² ☒ > 3 ft

D-MAINTENANCE
- ☐ Public ☐ Private
- ☐ Active ☐ Historic
- Succession: ☐ Young ☐ Old
- ☐ Spray ☐ Islands ☒ Scoured
- Snag : ☐ Removed ☐ Modified
- Levee: ☐ One-sided ☐ Both banks
- ☐ Relocated ☐ Cutoffs
- Bedload: ☒ Moving ☐ Stable
- ☐ Armoured ☐ Stumps
- ☐ Impounded ☐ Desiccated
- ☐ Flood control ☐ Drainage

E-ISSUES
- ☐ WWTP ☐ CSO ☐ NPDES
- ☐ Industry ☐ Urban
- ☐ Hardened ☐ Dirt & Grime
- ☐ Contaminated ☐ Landfill
- BMPs: ☐ Construction ☐ Sediment
- ☐ Logging ☐ Irrigation ☐ Cooling
- Erosion: ☐ Bank ☐ Surface
- ☐ False bank ☐ Manure ☐ Lagoon
- ☐ Wash H_2O ☐ Tile ☐ H_2O Table
- Mine: ☐ Acid ☐ Quarry
- Flow: ☐ Natural ☐ Stagnant
- ☐ Wetland ☐ Park ☐ Golf
- ☐ Lawn ☐ Home
- ☐ Atmospheric deposition

Looking upstream (> 10m, 3 readings; < 10m, 1 reading in middle); Round to the nearest whole percent

	Left	Middle	Right	Total Average
% open	___ %	___ %	___ %	___ %

Stream Drawing:

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS

STREAM NAME		LOCATION AS 6 (North) → ACTUALLY AS5
STATION #	REACH ID#	STREAM CLASS
UTM N	UTM E	RIVER BASIN
STORET #		AGENCY
INVESTIGATORS		
FORM COMPLETED BY	DATE TIME PM	REASON FOR SURVEY

See Attached

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 4	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 (4) 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE 7	20 19 18 17 16	15 14 13 12 11	10 9 8 (7) 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE 7	20 19 18 17 16	15 14 13 12 11	10 9 8 (7) 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 10	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 16	20 19 18 17 (16)	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks, and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 1	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 (1) 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE 1	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 (1) 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 8 (LB)	Left Bank 10 9	(8) 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	(8) 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 8 (LB)	Left Bank 10 9	(8) 7 6	5 4 3	2 1 0
SCORE 8 (RB)	Right Bank 10 9	(8) 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 9 (LB)	Left Bank 10 (9)	8 7 6	5 4 3	2 1 0
SCORE 9 (RB)	Right Bank 10 (9)	8 7 6	5 4 3	2 1 0

Total Score 96

Appendix 10.4 Blank OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index) form (front)

IDEM

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

Sample #	bioSample #	Stream Name	Location
AS-6	—	Pigeon Creek	38.06617, -87.39379

Surveyor	Sample Date	County	Macro Sample Type	☒ Habitat Complete	QHEI Score:
Eco-Tech	8/22/17	Warrick	MHAB, Fish		52

1] *SUBSTRATE* Check ONLY Two predominant substrate TYPE BOXES; estimate % and check every type present

BEST TYPES (PREDOMINANT P R / PRESENT P R / TOTAL %)
- ☐☐ BLDR/SLABS [10] ☐☐ ____
- ☐☐ BOULDER [9] ☐☐ ____
- ☐☐ COBBLE [8] ☐☐ ____
- ☐☐ GRAVEL [7] ☐☐ ____
- ☒☐ SAND [6] ☐☐ ____
- ☐☐ BEDROCK [5] ☐☐ ____

NUMBER OF BEST TYPES: ☐ 4 or more [2] ☐ 3 or less [0]

OTHER TYPES (PREDOMINANT P R / PRESENT P R / TOTAL %)
- ☐☐ HARDPAN [4] ☐☐ ____
- ☐☐ DETRITUS [3] ☐☐ ____
- ☐☐ MUCK [2] ☐☐ ____
- ☒☐ SILT [2] ☐☐ ____
- ☐☐ ARTIFICIAL [0] ☐☐ ____

(Score natural substrates; ignore sludge from point-sources)

ORIGIN Check ONE (Or 2 & average)
- ☐ LIMESTONE [1]
- ☐ TILLS [1]
- ☐ WETLANDS [0]
- ☐ HARDPAN [0]
- ☐ SANDSTONE [0]
- ☐ RIP/RAP [0]
- ☐ LACUSTRINE [0]
- ☐ SHALE [-1]
- ☐ COAL FINES [-2]

QUALITY

SILT
- ☒ HEAVY [-2]
- ☐ MODERATE [-1]
- ☐ NORMAL [0]
- ☐ FREE [1]

EMBEDDEDNESS
- ☒ EXTENSIVE [-2]
- ☐ MODERATE [-1]
- ☐ NORMAL [0]
- ☐ NONE [1]

Substrate: 6 (Maximum 20)

Comments

2] *INSTREAM COVER* Indicate presence 0 to 3 and estimate percent: **0**-Absent; **1**-Very small amounts or if more common of marginal quality; **2**-Moderate amounts, but not of highest quality or in small amounts of highest quality; **3**-Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed root wad in deep/fast water, or deep, well-defined, functional pools.)

%	Amount		%	Amount		%	Amount	
5	1	UNDERCUT BANKS [1]		2	POOLS > 70cm [2]		0	OXBOWS, BACKWATERS [1]
	0	OVERHANGING VEGETATION [1]			ROOTWADS [1]			AQUATIC MACROPHYTES [1]
5	1	SHALLOWS (IN SLOW WATER) [1]		0	BOULDERS [1]	20	2	LOGS OR WOODY DEBRIS [1]
	0	ROOTMATS [1]						

AMOUNT Check ONE (Or 2 & average)
- ☐ EXTENSIVE > 75% [11]
- ☐ MODERATE 25 - 75% [7]
- ☒ SPARSE 5 - < 25% [3]
- ☐ NEARLY ABSENT < 5% [1]

Cover: 8 (Maximum 20)

Comments

3] *CHANNEL MORPHOLOGY* Check ONE in each category (Or 2 & average)

SINUOSITY
- ☐ HIGH [4]
- ☐ MODERATE [3]
- ☐ LOW [2]
- ☒ NONE [1]

DEVELOPMENT
- ☐ EXCELLENT [7]
- ☐ GOOD [5]
- ☐ FAIR [3]
- ☒ POOR [1]

CHANNELIZATION
- ☐ NONE [6]
- ☒ RECOVERED [4]
- ☐ RECOVERING [3]
- ☐ RECENT OR NO RECOVERY [1]

STABILITY
- ☐ HIGH [3]
- ☐ MODERATE [2]
- ☒ LOW [1]

Channel: 7 (Maximum 20)

Comments

4] *BANK EROSION AND RIPARIAN ZONE* Check ONE in each category for EACH BANK (Or 2 per bank & average)

River right looking downstream

EROSION (L R)
- ☒☒ NONE/LITTLE [3]
- ☐☐ MODERATE [2]
- ☐☐ HEAVY/SEVERE [1]

RIPARIAN WIDTH (L R)
- ☒☒ WIDE > 50m [4]
- ☐☐ MODERATE 10-50m [3]
- ☐☐ NARROW 5-10m [2]
- ☐☐ VERY NARROW [1]
- ☐☐ NONE [0]

FLOOD PLAIN QUALITY (L R)
- ☒☒ FOREST, SWAMP [3]
- ☐☐ SHRUB OR OLD FIELD [2]
- ☐☐ RESIDENTIAL, PARK, NEW FIELD [1]
- ☐☐ FENCED PASTURE [1]
- ☐☐ OPEN PASTURE, ROWCROP [0]
- ☐☐ CONSERVATION TILLAGE [1]
- ☐☐ URBAN OR INDUSTRIAL [0]
- ☐☐ MINING / CONSTRUCTION [0]

Indicate predominant land use(s) past 100m riparian.

Riparian: 10 (Maximum 10)

Comments

5] *POOL/GLIDE AND RIFFLE/RUN QUALITY*

MAXIMUM DEPTH Check ONE (ONLY!)
- ☒ > 1m [6]
- ☐ 0.7 - < 1m [4]
- ☐ 0.4 - < 0.7m [2]
- ☐ 0.2 - < 0.4m [1]
- ☐ < 0.2m [0]

CHANNEL WIDTH Check ONE (Or 2 & average)
- ☒ POOL WIDTH > RIFFLE WIDTH [2]
- ☐ POOL WIDTH = RIFFLE WIDTH [1]
- ☐ POOL WIDTH < RIFFLE WIDTH [0]

CURRENT VELOCITY Check ALL that apply
- ☐ TORRENTIAL [-1]
- ☐ VERY FAST [1]
- ☐ FAST [1]
- ☐ MODERATE [1]
- ☒ SLOW [1]
- ☐ INTERSTITIAL [-1]
- ☐ INTERMITTENT [-2]
- ☐ EDDIES [1]

Indicate for reach - pools and riffles.

Recreation Potential (Circle one and comment on back)
- ☐ Primary Contact
- ☐ Secondary Contact

Pool/Current: 9 (Maximum 12)

Comments

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species:

Check ONE (Or 2 & average) ☐ NO RIFFLE [metric = 0]

RIFFLE DEPTH
- ☐ BEST AREAS > 10cm [2]
- ☐ BEST AREAS 5 - 10cm [1]
- ☒ BEST AREAS < 5cm [metric = 0]

RUN DEPTH
- ☒ MAXIMUM > 50cm [2]
- ☐ MAXIMUM < 50cm [1]

RIFFLE/RUN SUBSTRATE
- ☐ STABLE (e.g., Cobble, Boulder) [2]
- ☐ MOD. STABLE (e.g., Large Gravel) [1]
- ☒ UNSTABLE (e.g., Fine Gravel, Sand) [0]

RIFFLE/RUN EMBEDDEDNESS
- ☒ NONE [2]
- ☐ LOW [1]
- ☐ MODERATE [0]
- ☐ EXTENSIVE [-1]

Riffle/Run: 4 (Maximum 8)

Comments

6] *GRADIENT* (2.64 ft/mi)
- ☐ VERY LOW - LOW [2-4]
- ☒ MODERATE [6 - 10]
- ☐ HIGH - VERY HIGH [10 - 6]

DRAINAGE AREA (22.5 mi²)

%POOL: 70 %GLIDE: 30

%RUN: X %RIFFLE: X

Gradient: 8 (Maximum 10)

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IDEM

OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index)

COMMENT

A-CANOPY
- ☐ >85%-Open
- ☐ 55%-<85%
- ☐ 30%-<55%
- ■ 10%-<30%
- ☐ <10%-Closed

B-AESTHETICS
- ☐ Nuisance algae
- ☐ Invasive macrophytes
- ■ Excess turbidity
- ☐ Discoloration
- ☐ Foam/Scum
- ☐ Oil sheen
- ■ Trash/Litter
- ☐ Nuisance odor
- ☐ Sludge deposits
- ☐ CSOs/SSOs/Outfalls

C-RECREATION

Area Depth
Pool: ☐ > 100 ft² ☐ >3 ft

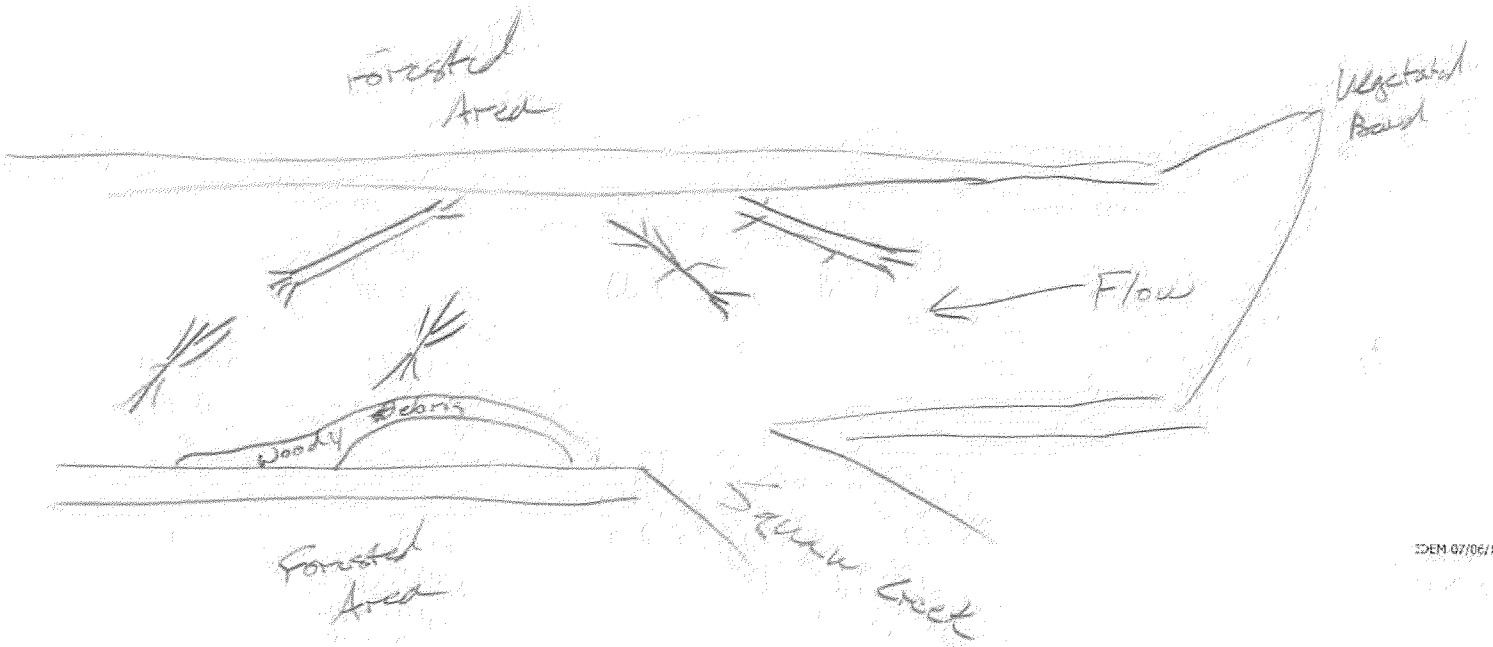
D-MAINTENANCE
- ☐ Public ☐ Private
- ☐ Active ☐ Historic
- Succession: ☐ Young ☐ Old
- ☐ Spray ☐ Islands ☐ Scoured
- Snag: ☐ Removed ☐ Modified
- Leveed: ☐ One sided ☐ Both banks
- ☐ Relocated ☐ Cutoffs
- Bedload: ☐ Moving ☐ Stable
- ☐ Armoured ☐ Slumps
- ☐ Impounded ☐ Desiccated
- ☐ Flood control ☐ Drainage

E-ISSUES
- ☐ WWTP ☐ CSO ☐ NPDES
- ☐ Industry ☐ Urban
- ☐ Hardened ☐ Dirt & Grime
- ☐ Contaminated ☐ Landfill
- BMPs: ☐ Construction ☐ Sediment
- ☐ Logging ☐ Irrigation ☐ Cooling
- Erosion: ☐ Bank ☐ Surface
- ☐ False bank ☐ Manure ☐ Lagoon
- ☐ Wash H_2O ☐ Tile ☐ H_2O Table
- Mine: ☐ Acid ☐ Quarry
- Flow: ☐ Natural ☐ Stagnant
- ☐ Wetland ☐ Park ☐ Golf
- ☐ Lawn ☐ Home
- ☐ Atmospheric deposition

Looking upstream (> 10m, 3 readings; < 10m, 1 reading in middle); Round to the nearest whole percent

	Left	Middle	Right	Total Average
% open	___ %	___ %	___ %	___ %

Stream Drawing: AS6



IDEM 07/06/10

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS

STREAM NAME		LOCATION
STATION #	REACH ID#	STREAM CLASS
UTM N	UTM E	RIVER BASIN
STORET #		AGENCY
INVESTIGATORS		
FORM COMPLETED BY	DATE / TIME PM	REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE 4	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 (4) 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE 7	20 19 18 17 16	15 14 13 12 11	10 9 8 (7) 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE 9	20 19 18 17 16	15 14 13 12 11	10 (9) 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE 10	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE 16	20 19 18 17 (16)	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE 6	20 19 18 17 16	15 14 13 12 11	10 9 8 7 (6)	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE 1	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 (1) 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE 7 (LB)	Left Bank 10 (9)	8 7 6	5 4 3	2 1 0
SCORE 7 (RB)	Right Bank 10 (9)	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE 8 (LB)	Left Bank 10 9	(8) 7 6	5 4 3	2 1 0
SCORE 4 (RB)	Right Bank 10 9	(8) 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE 10 (LB)	Left Bank (10) 9	8 7 6	5 4 3	2 1 0
SCORE 10 (RB)	Right Bank (10) 9	8 7 6	5 4 3	2 1 0

Total Score 107

Project: LV2017025 - Seven Hills Ecological Assessment

Description: Physical parameter data from Pigeon Creek (Warrick Co, IN) on 8/22/2017. collector: THullihen, RNavy.

SV ID	Latitude	Longitude	Water or Temp	DO mg/L	pH	Specific Conductivity µS/L
AS 5	38.16132	-87.415476	22.5	3.87	7.9	3487
AS 3	38.136306	-87.402616	22.9	3.90	8.0	3302
AS 2	38.103602	-87.406125	25.8	3.80	8.2	1723
AS 1	38.095733	-87.399227	22.7	4.00	8.1	2250
AS 6	38.06617	-87.39379	23.2	4.05	8.2	3230
AS 4	38°7'46.55"	87°24'0.61"	ND	Water		

Scale: 1 square = _____

APPENDIX C.

RAW DATA-WATER CHEMISTRY, MACROINVERTEBRATES, FISH

RoseDale Services, Inc.

1125 E. Walnut Street
Boonville, IN 47601

Eco-Tech Consultants, Inc.
311 Clark Station Road
Fisherville, KY 40023

Lab Number: 2017-0199-01
Date Received: 8/29/2017
Date Reported: 9/8/2017

Sample Identification

AS-1

Date Sampled: 8/29/2017
Time Sampled:
Sampled by: ***

Sample Analysis

Parameter	Result		Method	Analyst	Analysis Date/Time
Acidity as CaCO3	<10	mg/L	SM 2310 B-1997	CRB	9/1/2017 8:31
Alkalinity as CaCO3	313	mg/L	SM 2320 B-1997	CRB	9/1/2017 8:31
Iron	0.16	mg/L	SM 3500 FE-1997 / Hach 8008	MJL	9/7/2017 13:00
Metals Analysis Preparation	Completed		EPA 200.7 Rev. 4.4	CRB	9/5/2017 9:10
Manganese	<0.1	mg/L	SM 3500 MN-B-1999 / Hach 8034	MJL	9/7/2017 15:10
Solids, Total Suspended	<10	mg/L	SM 2540 D-1997	CVB	9/1/2017 8:45

*** Performed by client

Reviewed by Rodger Wilson

Phone: 812-897-2530 • Fax: 812-897-2531

RoseDale Services, Inc.

1125 E. Walnut Street
Boonville, IN 47601

Eco-Tech Consultants, Inc.
311 Clark Station Road
Fisherville, KY 40023

Lab Number: 2017-0199-02
Date Received: 8/29/2017
Date Reported: 9/8/2017

Sample Identification

AS-2

Date Sampled: 8/29/2017
Time Sampled:
Sampled by: ***

Sample Analysis

Parameter	Result		Method	Analyst	Analysis Date/Time
Acidity as CaCO3	<10	mg/L	SM 2310 B-1997	CRB	9/1/2017 8:31
Alkalinity as CaCO3	280	mg/L	SM 2320 B-1997	CRB	9/1/2017 8:31
Iron	<0.1	mg/L	SM 3500 FE-1997 / Hach 8008	MJL	9/7/2017 13:00
Metals Analysis Preparation	Completed		EPA 200.7 Rev. 4.4	CRB	9/5/2017 9:10
Manganese	<0.1	mg/L	SM 3500 MN-B-1999 / Hach 8034	MJL	9/7/2017 15:10
Solids, Total Suspended	10	mg/L	SM 2540 D-1997	CVB	9/1/2017 8:45

*** Performed by client

Reviewed by Rodger Wilson

Phone: 812-897-2530 • Fax: 812-897-2531

RoseDale Services, Inc.

1125 E. Walnut Street
Boonville, IN 47601

Eco-Tech Consultants, Inc.
311 Clark Station Road
Fisherville, KY 40023

Lab Number: 2017-0199-03
Date Received: 8/29/2017
Date Reported: 9/8/2017

Sample Identification

AS-3

Date Sampled: 8/29/2017
Time Sampled:
Sampled by: ***

Sample Analysis

Parameter	Result		Method	Analyst	Analysis Date/Time
Acidity as CaCO3	<10	mg/L	SM 2310 B-1997	CRB	9/1/2017 8:31
Alkalinity as CaCO3	256	mg/L	SM 2320 B-1997	CRB	9/1/2017 8:31
Iron	<0.1	mg/L	SM 3500 FE-1997 / Hach 8008	MJL	9/7/2017 13:00
Metals Analysis Preparation	Completed		EPA 200.7 Rev. 4.4	CRB	9/5/2017 9:10
Manganese	<0.1	mg/L	SM 3500 MN-B-1999 / Hach 8034	MJL	9/7/2017 15:10
Solids, Total Suspended	11.7	mg/L	SM 2540 D-1997	CVB	9/1/2017 8:45

*** Performed by client

Reviewed by Rodger Wilson

Phone: 812-897-2530 • Fax: 812-897-2531

RoseDale Services, Inc.

1125 E. Walnut Street
Boonville, IN 47601

Eco-Tech Consultants, Inc.
311 Clark Station Road
Fisherville, KY 40023

Lab Number: 2017-0199-05
Date Received: 8/29/2017
Date Reported: 9/8/2017

Sample Identification

AS-6

Date Sampled: 8/29/2017
Time Sampled:
Sampled by: ***

Sample Analysis

Parameter	Result		Method	Analyst	Analysis Date/Time
Acidity as CaCO3	<10	mg/L	SM 2310 B-1997	CRB	9/1/2017 8:31
Alkalinity as CaCO3	255	mg/L	SM 2320 B-1997	CRB	9/1/2017 8:31
Iron	0.18	mg/L	SM 3500 FE-1997 / Hach 8008	MJL	9/7/2017 13:00
Metals Analysis Preparation	Completed		EPA 200.7 Rev. 4.4	CRB	9/5/2017 9:10
Manganese	<0.1	mg/L	SM 3500 MN-B-1999 / Hach 8034	MJL	9/7/2017 15:10
Solids, Total Suspended	23.0	mg/L	SM 2540 D-1997	CVB	9/1/2017 8:45

*** Performed by client

Reviewed by Rodger Wilson

Phone: 812-897-2530 • Fax: 812-897-2531

RoseDale Services, Inc.

1125 E. Walnut Street
Boonville, IN 47601

Eco-Tech Consultants, Inc.
311 Clark Station Road
Fisherville, KY 40023

Lab Number: 2017-0199-04
Date Received: 8/29/2017
Date Reported: 9/8/2017

Sample Identification

AS-5

Date Sampled: 8/29/2017
Time Sampled:
Sampled by: ***

Sample Analysis

Parameter	Result		Method	Analyst	Analysis Date/Time
Acidity as CaCO3	<10	mg/L	SM 2310 B-1997	CRB	9/1/2017 8:31
Alkalinity as CaCO3	344	mg/L	SM 2320 B-1997	CRB	9/1/2017 8:31
Iron	<0.1	mg/L	SM 3500 FE-1997 / Hach 8008	MJL	9/7/2017 13:00
Metals Analysis Preparation	Completed		EPA 200.7 Rev. 4.4	CRB	9/5/2017 9:10
Manganese	<0.1	mg/L	SM 3500 MN-B-1999 / Hach 8034	MJL	9/7/2017 15:10
Solids, Total Suspended	<10	mg/L	SM 2540 D-1997	CVB	9/1/2017 8:45

*** Performed by client

Reviewed by Rodger Wilson

Phone: 812-897-2530 • Fax: 812-897-2531

Raw Macroinvertebrate data collected 8/28-29/2017 from streams sampled within the proposed Seven Hills Mine in Warrick County, Indiana.

AQUATIC SITE				AS1	AS2	AS3	AS5	AS6
DATE				8/29/17	8/29/17	8/29/17	8/28/17	8/29/17
SPECIES	T.V.	F.F.G.	Habit					
PLATYHELMINTHES								
Turbellaria								
Tricladida								
Planariidae								
Girardia (Dugesia) tigrina					1			
MOLLUSCA								
Bivalvia								
Veneroida								
Corbiculidae								
Corbicula fluminea	6	FC		8				6
Gastropoda								
Basommatophora								
Physidae								
Physella sp.	8	SC		1		1		
ANNELIDA								
Oligochaeta	8	GC	bu					
Clitellata								
Tubificida								
Naididae	8	GC						
Naidinae								
Nais pardalis	8	GC			1			
Tubificinae w.o.h.c.	10	GC	bu	1	1		3	
Pristininae								
Pristina sp.	8	GC			1			
Pristina aequiseta	8	GC			3			
Rhyacodrilinae								
Branchiura sowerbyi	6	GC	bu		3		1	
ARTHROPODA								
Arachnoidea								
Acariformes								
Oribatei							1	
Crustacea								
Amphipoda								
Talitridae								
Hyalella azteca	8	GC	cr	5		6		9

Asellidae								
Caecidotea sp.	8	GC	cr	2				
Insecta								
Collembola								
Sminthuridae								1
Ephemeroptera								
Baetidae								
Callibaetis floridanus		GC		3		10	1	3
Caenidae								
Caenis sp.	3	GC	sw		4		1	
Odonata								
Calopterygidae								
Calopteryx sp.	4	PR						2
Hetaerina sp.	3	PR					1	
Coenagrionidae						1		
Argia sp.	5	PR		1	4	3		1
Enallagma sp.	9	PR		2	1	6	1	1
Ischnura sp.	9	PR	cb	2	1	4		1
Corduliidae								
Epitheca princeps		PR	sp			2		
Macromia sp.	2	PR		1				
Libellulidae				1		1		
Erythemis sp.	2	PR		2				
Libellula sp.	9	PR						1
Pachydiplax longipennis		PR						3
Heteroptera								
Belostomatidae		PR		2				
Gerridae		PR						
Aquarius		PR	sw			1		
Nepidae								
Ranatra sp.		PR				3		
Megaloptera								
Corydalidae								
Corydalus cornutus	2	PR		3			1	
Trichoptera								
Hydropsychidae							4	4
Hydropsyche sp.	4	FC	cn	10	1	1	9	4
Cheumatopsyche sp.	3	FC	cn	57	87		79	20
Hydroptilidae								
Hydroptila sp.	3	SC	cn				6	2
Neotrichia sp.	4	SC					4	
Polycentropodidae								
Neureclipsis sp.	3	FC		1			1	

Coleoptera								
Dytiscidae		PR				1		
Elmidae								
Stenelmis sp.	5	SC	cn			1		
Gyrinidae								
Dineutus sp.	4	PR		2				8
Haliplidae								
Peltodytes sp.	7	SH	cb				1	1
Hydrophilidae								
Berosus sp.	7	PR		1			2	
Diptera								
Chaoboridae								
Chaoborus punctipennis						1		
Chironomidae	6	FC				1		
Chironominae								
Chironomini								
Chironomus sp.	8	GC	bu	1		1	59	
Cryptochironomus sp.	5	PR	sp			1	7	1
Cryptotendipes sp.	4	GC	bu			2		
Dicrotendipes neomodestus	5	FC		5		12	10	4
Endochironomus sp.	6	SH	cn			1		
Glyptotendipes sp.	6	FC	bu	3	82	1		2
Parachironomus sp.	4	PR	sp		1	1		
Paracladopelma sp.	7	GC					3	
Phaenopsectra obediens group		OM				2		
Polypedilum flavum				28	3		3	4
Polypedilum halterale group						1		
Polypedilum illinoense group	7			23	1	24	133	39
Polypedilum sp.		SH	cb		1			
Tribelos fuscicorne							7	1
Tribelos jucundus								1
Pseudochironomini								
Pseudochironomus sp.							59	
Tanytarsini								
Cladotanytarsus sp.	4	GC	cb	1		1		
Paratanytarsus dissimilis						2		
Rheotanytarsus exiguus gp.		FC			11			
Tanytarsus sp.	4	FC	cb	1	3	2	3	6
Orthocladiinae								

Corynoneura sp.	4	GC	sp	1				
Cricotopus bicinctus	7	OM		3			14	2
Rheocricotopus robacki	4			1				
Thienemanniella xena	4	GC						2
Tanypodinae								
Ablabesmyia mallochi	5	OM		6		10	3	4
Ablabesmyia rhamphe group				9		5		2
Conchapelopia sp.	4	PR		20		5	66	7
Labrundinia sp.	4	PR	sp			1		
Procladius sp.	7	PR	sp	4		8	7	8
Telopelopia okoboji	4			5				
Empididae							1	
Hemerodromia sp.			sp				3	
Muscidae	6	PR					1	
Simuliidae								
Simulium sp.	5	FC	cn		2			

Raw fish data collected 8-29-17 from streams sampled within the proposed Seven Hills Mine in Warrick County, Indiana.

Species	Common Name	AS 1	AS2	AS3	AS5	AS6	Family/Group	IBI Trophic Guild Assignment	IBI Sensitivity	Repro. Guild	Pioneer?	Schooling?
Ameiurus natalis	yellow bullhead		1				Ictaluridae	V	T	C		
Amia calva	bowfin			1			Amiidae	C		C		
Aphredoderus sayanus	pirate perch			1			Aphredoderidae	V		M		
Cyprinella whipplei	steelcolor shiner				11		Cyprinidae	V		M		TRUE
Gambusia affinis	mosquitofish				1	12	Poeciliidae	V		N		
Ictalurus punctatus	channel catfish			1			Ictaluridae	C	T	C		
Lepomis cyanellus	green sunfish	4	5	7	8		Sunfish	V	T	C	TRUE	
Lepomis gulosus	warmouth	2	4	1		1	Sunfish	C		C		
Lepomis macrochirus	bluegill	10	15	3		4	Sunfish	V		C		
Lepomis megalotis	long-eared sunfish	4		3		2	Sunfish	V	SI	C		
Lepisosteus osseus	longnose gar				1		Lepisosteidae	C	T	M		
Micropterus punctulatus	Kentucky bass	1		1	1	1	Centrarchidae	C		C		
Micropterus salmonoides	largemouth bass		4				Centrarchidae	C		C		
Percina sciera	dusky darter				1	1	Percidae	V	S	S		
Phenacobius mirabilis	suckermouth minnow	4			20		Cyprinidae	V		S		TRUE
Pimephales notatus	bluntnose minnow	5			7		Cyprinidae	D	T	C	TRUE	TRUE
# individuals		30	29	18	50	21						
# species		7	5	8	8	6						
% deformed		3.33%	3.45%	0.00%	0.00%	0.00%						
Total Individuals							**77**					

* exotic species

IBI Trophic Guild Assignment = Detritivore-D, Omnivore-O, Invertivore-V, Insectivore-I, Carnivore-C

IBI Sensitivity = Sensitive-S, Intolerant-I, Both Sensitive & Intolerant (SI), Tolerant-T

Reproductive Guild = Simple lithophil-S, Complex with parental care-C, Simple miscellaneous-M, Complex with no parental care-N

APPENDIX D.

DATA TABLES OF PREVIOUS SURVEY EFFORT (2011)-WATER CHEMISTRY, MACROINVERTEBRATES, FISH

Appendix D Table 1. Stream characteristics at aquatic sample sites within the proposed Seven Hills Mine in Warrick County, Indiana.

Sample Site	Stream	Flow Regime	Bankfull Width (ft)	Mean Bankfull Depth (ft)	Slope	Channel Material	RBP Score	Rosgen Stream Type*
AS1	6	Per	45.1	2.7	0.03	Silt	126	F5/F6
AS2	5	Int	6.5	0.3	0.01	Gravel	47	C6
AS3	11	Per	63	2.6	0.02	Silt	126	F5/F6

*Rosgen 1996

Appendix D Table 2. Physical and chemical measurements of water in streams within the proposed Seven Hills Mine in Warrick County, Indiana as compared to Indiana NPDES discharge standards and Minimum Surface Water Quality standards.

Parameter	AS1	AS2	AS3	NPDES Discharge Limits	Surface Water Quality Standards
Temperature (°C)	17.5	17.5	18.9	≤32.2	≤32.2
Flow Rate (ft/second)	0.72	0.31	1.12	NA	NA
pH	8.3	8.8	8.4	6.0 - 9.0	6.0 - 9.0
Total Dissolved Solids (mg/L)	1588	863	1129	NA	<750
Total Acidity (mg/L as CaCo3)	<10	<10	<10	NA	NA
Total Alkalinity (mg/L as CaCo3)	380	330	280	NA	NA
Total Iron (mg/L)	0.79	0.1	0.47	<6.0	NA
Total Manganese (mg/L)	0.19	0.02	0.066	<4.0	NA
Total Suspended Solids (mg/L)	39	24	25	<70	NA

Appendix D Table 3. Metrics used to calculate the macroinvertebrate Index of Biotic Integrity and resulting scores for streams sampled within the proposed Seven Hills Mine in Warrick County, Indiana.

Parameter	AS1		AS2		AS3	
	Value	Score	Value	Score	Value	Score
Number of Taxa	8	1	19	1	18	1
Number of Individuals	26	1	86	1	129	3
Number of EPT Taxa	1	1	1	1	3	1
% Orthocladiinae + Tanytarsini of Chironomidae	0.0%	5	0.0%	5	14.3%	5
% Non-insects Minus Crayfish	5.4%	5	19.8%	3	9.3%	5
Number of Diptera Taxa	1	1	6	1	3	1
% Intolerant	7.7%	1	11.6%	1	39.5%	5
% Tolerant	11.5%	5	14.0%	3	0.8%	5
% Predators	42.3%	5	59.3%	5	20.9%	3
% Shredders + Scrapers	15.4%	3	15.1%	3	31.0%	5
% Collector-Filterers	7.7%	5	11.6%	3	36.4%	1
% Sprawlers	0.0%	1	3.5%	3	0.0%	1
Total Scores		**34**		**30**		**36**

*<36=impaired, >36=unimpaired.

Appendix D Table 4. Fish community metrics used to calculate the Index of Biotic Integrity and resulting scores for streams sampled within the proposed Seven Hills Mine in Warrick County, Indiana.

	AS1		AS2		AS3	
Parameter	Value	Score	Value	Score	Value	Score
Number of Species	13	5	7	1	18	5
Number of Minnow Species	2	3	1	1	5	3
Number of Sunfish Species	5	5	2	3	5	5
Number of Sucker Species	0	1	0	1	0	1
Number of Sensitive Species	0	5	0	1	1	1
% Tolerant	21%	5	50%	3	22%	5
% Omnivore	5%	5	2%	5	4%	5
% Insectivore	84%	5	98%	5	84%	5
% Pioneer	11%	5	NA		NA	
% Carnivore	NA		2%	1	13%	3
Total # Individuals	62	1	148	3	85	1
% Simple Lithophilic Individuals	2%	1	0%	1	1%	1
% Individuals with Deformities	2%	3	1%	5	0%	5
Total Scores		**44**		**30**		**40**
Qualitative Rating*		**Fair**		**Poor**		**Fair**

*58-60=Excellent, 48-52=Good, 40-44=Fair, 28-34=Poor, 12-22=Very Poor, <12=No Fish